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PLECTANIA COCCINEA

FRED J. SEAVER

(WITH COLORED ILLUSTRATION)

Some of my earliest and most cherished memories as a student in the State University of Iowa are the frequent rambles in company with the late Professor B. Shimek over the hills and along the banks of the Iowa River and some of its tributaries, especially Turkey Creek, the scene of many a happy outing.

And how well do I recall the thrill when first encountering the brilliant "scarlet cup" (*Plectania coccinea*), as it beamed up as though to welcome us for this is one of the harbingers of springtime, and one of the first of its kind to appear when the snow is gone. Occasionally one may be found in the very late autumn, but it is essentially a spring species.

This, most beautiful of its group, did much to arouse in me an interest in the study of the cup-fungi, and perhaps more than any other one thing is responsible for the shaping of my career in life. I feel, therefore, that it is entitled to a prominent place in the present publication.

Copy for the accompanying illustration was supplied by Dr. B. O. Dodge, and was made by Clara D. Epling from material collected by him in Wisconsin for the species has a wide distribution throughout North America and Europe, but often like the "modest violet" remains unseen except as it is spied by the prying eyes of the naturalist. The reproduction is about natural size.

No reprints of this note will be made, but the illustration appears in the Supplemented Edition of North American Cup-fungi, just off the press.

THE NEW YORK BOTANICAL GARDEN

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THE SPHERICAL GALL RUST OF JACK PINE

RENÉ POMERLEAU

(WITH 1 FIGURE)

Three types of gall rusts have been found in Quebec on *Pinus Banksiana*. Two of them are well known: the fusiform gall caused by *Cronartium Commandrae* and the effused gall of the base of the stem caused by *C. Comptoniae*. A third type, which has been observed for several years in Quebec, presents true globose galls (FIG. 1, *A*, *B*, *C*) related to the eastern gall rust of *Cronartium Quercuum* and more closely to the western one known under the name of *C. coleosporioides*.

Although the existence of *C. Quercuum* has been mentioned on *Pinus Banksiana* of the northeast, all spherical galls cannot easily be considered as belonging to this species. These galls are mostly found in far north regions where oak, the alternate host, is from 200 to 300 miles distant at least.

The known range of *C. coleosporioides* of western species of hard pines has also left much doubt on the possible relationship with our eastern gall on Jack Pine. The striking similarity of this disease with the Woodgate rust of *Pinus sylvestris*, so common in plantations in this part of the continent, has also complicated the problem.

Several attempts have been made to directly inoculate pine by aeciospores but no successful result was obtained. This problem was left unsolved for many years up to the end of the summer 1941. In a Jack Pine stand, located on the north shore of the St. Lawrence River at about 300 miles northeast of Quebec city, the author was looking for possible secondary hosts of the two existing pine rusts: the fusiform and the spherical type, when the telial stage of *C. Commandrae* was abundantly found on *Commandra livida*. Associated with this herbaceous plant and shrubby species like *Vaccinium Vitis-Idaea* and *V. pennsylvanicum*, another plant, identified as *Melampyrum lineare* was also found bearing telial columns (FIG. 1, *D*).

FIG. 1. *Cronartium coleosporoides: A, B* and *C,* spherical galls on *Pinus Banksiana; D,* telia on *Melampyrum lineare.*

Back in laboratory, this discovery was studied and compared with descriptions of *Cronartium* species given in Arthur's manual and no important difference was noted between our collection and the diagnosis of *C. coleosporioides* of western pines.

Since that time another abundant collection of this rust was made at Three-Rivers on the same plant and an earlier collection made many years ago by Professor Marie-Victorin in Lake St. John district was obtained from the Montreal Botanical Garden. More recently, part of a collection of a rust on *Rhinanthus borealis* from the north shore of St. Lawrence River some years ago, was

obtained from Professor E. Campagna. This plant, which also belongs to the Scrophulariaceae, supports telia having the same characters.

Before definite proof of the relation between the rust on *Melampyrum* and spherical gall of Jack Pine by direct inoculation from one to the other host, the author feels it advisable in the meantime to propose the extension of range of *C. coleosporioides* to eastern America and to add *Pinus Banksiana* to its list of aecial host.

SPECIMENS EXAMINED: Mycological Herbarium of the Division of Forest Pathology, Quebec. On *Pinus Banksiana: 687,* June 1, 1934, *945,* June 15, 1934, *2242,* June 30, 1939, T. Barry, Oskelaneo River, Quebec; *3650,* May 30, 1941, Lac Duparquet, Quebec, R. Pomerleau, *3701,* June 2, 1941, Oskelaneo River, Quebec, R. Pomerleau; *3810,* August 10, 1941, Godbout, Quebec, R. Pomerleau; *3815,* June 1929, Ste. Anne de la Pocatière, Quebec, E. Campagna. On *Melampyrum lineare: 3812,* August 10, 1941, Godbout, Quebec, R. Pomerleau; *3925,* August 23, 1941; Three-Rivers, Quebec, R. Pomerleau.

Herbarium of the Montreal Botanical Institute, on *Melampyrum lineare: 16211,* July 5, 1921, Lake St. John. "La Pipe," Quebec, Victorin.

Mycological Herbarium of the Agricultural School, Ste. Anne de la Pocatière, on *Rhinanthus borealis: 8790* (*3814* forest pathology, Quebec), July 27, 1935, Bergeronnes, Quebec, P. Gauthier.

DIVISION OF FOREST PATHOLOGY,
DEPARTMENT OF LANDS AND FORESTS,
QUEBEC

STUDIES ON THE USTILAGINALES OF THE WORLD II

GEORGE L. ZUNDEL [1]

During the progress in the preparation of a manuscript on the Ustilaginales of the World, a large number of specimens have been received for study and examination. The following nine species were studied and are believed to be new undescribed species. Names are therefore proposed together with the following descriptions.

Ustilago caulicola Zundel, sp. nov.

Sori covering the stems and occasionally the leaves with a reddish-brown, semi-powdery spore mass, 10 cm. or more long; spores chiefly subglobose to ellipsoidal, rarely globose, irregular, light reddish-brown to almost hyaline, chiefly 7–9 μ long (rarely 12.5 μ long), thick epispore, spirally striate-echinulate.

Soris caulos et interdum folia tegentibus, massa sporarum rubro-brunnea et subpulverulenta, 10 cm. longis, sporis plerumque subglobosis vel ellipsoideis, rare globosis, irregularibus, dilute rubro-brunneis vel paene hyalinis, plerumque 7–9 μ longis (rare 12.5 μ); crasso episporo, helice striato-echinulato.

Hab. in *Polygono campanulato* f. *fulvido* Hook.

On *Polygonum campanulatum* var. *fulvidum* Hook. f., Chiang K'ou, Fan Ching Shan, China. Fungi of Kweichow Province, No. *622*. Coll. S. Y. Cheo, Oct. 1, 1931. Comm. Farlow Herbarium, Harvard University.

Ustilago epicampida Zundel, sp. nov.

Sori in the ovaries, infecting all of them, showing through the glumes, ovate, 1–2 mm. long, spore-mass agglutinated; spores globose to broadly ellipsoidal, reddish-brown, variable in size and

[1] The Latin descriptions were written by Dr. E. Robert Dengler, Prof. of Classical Languages, The Pennsylvania State College, but were not added until the time of proof reading. The cooperation of Dr. Dengler is acknowledged but any errors in printing must be charged to the author.

shape, 5.5–10.5 μ diameter, smooth but granular, most spores have a characteristic large vacuole giving the appearance of a thick irregular epispore.

Soris omnia ovaria invadentibus, per glumas visis, ovatis, 1–2 mm. longis, massa sporarum agglutinata; sporis globosis vel late ellipsoideis, rubro-brunneis, in magnitudine et forma variantibus, 5.5–10.5 diam., levibus sed granularibus, sporis plerumque praebentibus magnum vacuolum quod est crasso et irregulari episporo simile.
Hab. in *Epicampide emersleyi* (Vassey), Hitchcock.

On *Epicampes emersleyi* (Vassey) Hitchcock (Muhlembergia Emersleyi Vassey), Cerro Tancitaro (1100 ft.), Michoacan, Mexico. Coll. Wm. C. Leavenworth, Aug. 19, 1940. No. *718*. Comm. U. S. Dept. of Agric., Mycological Collections.

Ustilago Underwoodii Zundel, sp. nov.

Ustilago hypodytes (Schlecht.) Fries, p. p. Zundel in N. A. Flora **7**: 978. 1939.

Sori as dark colored striae between the veins of the leaves, finally causing the leaves to become shredded, spore-mass, dark-colored, powdery; spores chiefly globose to subglobose, light olivaceous-brown, chiefly 4–6 μ diameter, smooth.

Soris fuscis et striatiformibus inter venas foliorum, tandem folia concidentibus, massa sporarum fusca, pulverulenta; sporis plerumque globosis vel subglobosis, dilute olivaceo-brunneis, 4–6 μ diam., levibus.
Hab. in *Panico virgato* L.

On *Panicum virgatum* L., Dew Dorp, Staten Island, New York, coll. L. M. Underwood, June 1897 (type), also Richmond Valley, Richmond Co. (Staten Island), New York, June 16, 1917 by P. Wilson (Fungi within 100 miles of New York City, No. *541*); George M. Reed, June 19, 1917 (No. *2332*); L. A. Kolk, Sept. 19, 1939.

Sphacelotheca peruviana Zundel, sp. nov.

Sori destroying the ovaries, globose but somewhat flattened at the two poles, hard, about 1 mm. diameter, covered by a delicate whitish membrane that disintegrates into delicate sterile cells that soon collapse, spore mass agglutinated; sterile cells tinted olivaceous-yellow with a thick almost hyaline epispore, globose to subglobose, often irregular, chiefly 7–8 μ diameter, delicate and soon

collapsing; spores globose to somewhat subglobose, chiefly regular, light reddish-brown, chiefly 3–5 μ diameter, smooth, thick epispore.

Soris ovaria destruentibus, globosis sed aliquantum ad polos planis, duris, circa 1 mm. diam., membrana alba et delicata primo ambiente, deinde rupta in cellas delicatas sterilesque quae mox collabuntur, massa sporarum agglutinata; cellis sterilibus, olivaceo-flavis, episporo crasso, paene hyalino, globosis vel subglobosis, saepe irregularibus, 7–8 μ diam., delicatis et mox decidentibus; sporis globosis vel subglobosis, plerumque regularibus, dilute rubro-brunneis, 3–5 μ diam., levibus.

Hab. in *Sporobolo virginico* (L.) Kunth.

On *Sporobolus virginicus* (L.) Kunth., Paracas Bay, Near Pisco, Peru. Coll. H. O. Forbes, 1912, Comm. Agnes Chase (Type in U. S. D. A. Myc. Herb.).

Sphacelotheca utahensis Zundel, sp. nov.

Sori in the ovaries, ovoid, about 1.5–2 mm. long, covered by a delicate membrane that disintegrates into sterile cells, spore mass dark brown, powdery; sterile cells globose to elongated, often irregular, hyaline 7–14 μ long, smooth; spores globose to ellipsoidal, olivaceous brown, chiefly 8.5–10.5 μ long, apparently smooth but indistinctly echinulate under oil immersion.

Soris in ovariis, ovoideis, circa 1.5–2 mm. longis, membrana delicata in cellas steriles decidente, massa sporarum fusco-brunnea, pulverulenta; cellis sterilibus, globosis vel elongatis, saepe irregularibus, brunneis, plerumque 8.5–10.5 μ longis, apparenter levibus, sed, sub immersione ut dicunt olei visis, subechinulatis.

Hab. in *Sporobolo airoide* (Torr.) Torr.

On *Sporobolus airoides* (Torr.) Torr., Escalante Mountains, Garfield County, Utah (Montane Forest 7500). Coll. M. Stanton, June 20, 1932, No. *770*. Comm. J. A. Stevenson.

Sorosporium Chardonianum Zundel, sp. nov.

Sori destroying the inflorescence, 6–12 cm. long, at first covered by a brown membrane which soon distintegrates exposing a dark brown, granular, spore mass intermixed with long brown shreds; spore balls globose to ellipsoidal, often irregular, dark brown, semi-opaque, semi-permanent, composed of many spores, chiefly 35–70 μ long; spores globose to broadly ellipsoidal, often irregular or angular, olivaceous-brown, chiefly 9–11 μ diameter, outer spores slightly verruculate, inner spores smooth.

Soris inflorescentiam destruentibus, 6–12 cm. longis, membrana brunnea primo ambiente, deinde dissoluta massam sporarum fusco-brunneam et granu-

larem pannulis longis brunneisque intermixtam praebente; massa sporarum globosa vel ellipsoidea, saepe irregulari, atro-brunnea, semi-translucida, semipermanente, sporis numerosis, plerumque 35–70 μ longis, globosis vel late ellipsoideis, saepe irregularibus vel angularibus, olicaveo-brunneis, plerumque 9–11 μ diam., sporis externis leviter verruculatis, internis levibus.

Hab. in *Penniseto bambusiformi* (Tourn.) Hemsl.

On *Pennisetum bambusiforme* (Tourn.) Hemsl., Meridia, Venezuela. Coll. C. E. Chardon, December 4, 1936. Myc. Explor. Venezuela No. *1844* III.

Tilletia Festuca-octoflorana Zundel, sp. nov.

Sori in the ovaries, visible through the glumes, about 2 mm. long, 1 mm. wide, hard, olivaceous yellow; spores globose, subglobose to ellipsoidal, often irregular, with a halo around each spore, tinted, olivaceous-yellow to almost hyaline, chiefly 16–21 μ diameter, spiny, spines about 3.5 μ high; sterile cells or immature spores tinted olivaceous-yellow to almost hyaline, chiefly 8–10.5 μ diameter, each one with a halo, smooth.

Soris in ovariis, per glumas visis, ca. 2 mm. longis, 1 mm. latis, duris, olivaceo-flavis; sporis globosis vel subglobosis vel ellipsoideis, saepe irregularibus, nimbo sporam quamque circumambulante, olivaceo-flavis vel paene hyalinis, plerumque 16–21 μ diam., spinis ca. 3.5 μ altis; cellis sterilibus vel sporis immaturis olivaceo-flavis vel paene hyalinis, plerumque 8–10.5 μ diam., nimbo munitis, levibus.

Hab. in *Festuca octoflora* Walt.

On *Festuca octoflora* Walt., Tuscumbia, Miller Co., Missouri. Coll. Miss. Clara Fuhr. Comm. W. E. Maneval. Fall 1939.

Entyloma Astor-sericeanum Zundel, sp. nov.

Sori in the leaves, visible on both surfaces, flat, showing as inconspicuous yellowish spots, 0.5–1 mm. long, often coalescing and fusing into the surrounding green tissue without forming a definite margin; spores globose, regular, tinted yellow, chiefly 12–18 μ diameter, smooth but granular, thick epispore.

Soris in foliis, in utraque superficie visis, planis, in maculas sub-flavas et haud conspicuas congestis, 0.5–1 mm. longis, saepe coalescentibus et in circumdatum folium sine margine fusis; sporis globosis, regularibus, flavis, plerumque 12–18 μ diam., levibus sed granularibus, crasso episporo.

Hab. in *Astro sericeo* Vent.

On *Aster sericeus* Vent., sand plains, near Sauk City, Dana Co., Wisconsin (Type). Coll. H. C. Green, Sept. 20, 1940.

(?) **Entyloma Sprague**anum Zundel, sp. nov.

Sori on the leaves as elongated brown spots, slightly pustular, about 0.1–1 mm. long often coalescing; spores borne in rows between the veins, subglobose to ellipsoidal, clear olivaceous brown, chiefly 17.5–21 μ long, smooth, epispore 1.5–2.5 μ wide.

Soris in foliis, in maculis brunneis et elongatis, subpustularibus, ca. 0.1–1 mm. longis, saepe coalescentibus, in ordinibus inter venas visis, subglobosis vel ellipsoideis, pellucide olivaceo-brunneis, plerumque 17.5–21 μ longis, levibus, episporo 1.5–2.5 μ lato.

Hab. in *Poa pratensi* L.

On *Poa pratense* L., Taft siding, Traill Co., North Dakota. Coll. Dr. Roderick Sprague, May 3, 1940.

CONTRIBUTION DEPARTMENT OF BOTANY NO. 132,
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STUDIES IN THE GASTEROMYCETES V. A WHITE SIMBLUM

W. H. Long

(with 2 figures)

The winter of 1940–41 and the spring of 1941 were unusually wet for New Mexico, the state as a whole having two to three times the normal amount of precipitation. This produced very favorable conditions in the arid and semi-arid portions for the development of many species of saprophytic fungi, especially Gasteromycetes. These latter were abundant moreover in number of individual plants of a given species, particularly in the Lycoperdaceae and the Phallales.

Many specimens of *Simblum sphaerocephalum* have been found near Corona, New Mexico while the writer discovered a *white Simblum* growing near Albuquerque, N. M.

A truly white *Simblum* is a rarity in any country and none have been reported for North America. Occasionally albino specimens of normally red or yellow *Simblums* are found, especially of *S. sphaerocephalum,* but no consistently white plants of a *Simblum* were known to occur in this country until the discovery of the white plants here reported.

This white *Simblum* when fresh has a very pronounced amyl acetate odor, exactly like the yellow *S. texense,* previously described by the writer from Texas.[1] The plant also has several other characters common to *S. texense.* It is therefore made a variety of this species, since the writer does not consider the differences sufficient to warrant a new species.

Simblum texense var. **albidum** var. nov.

Sporophore when young (egg stage) obovate to turbinate, 2–4 cm. across by 3–5 cm. tall with a strong radicating base having

[1] Long, W. H. The Phalloideae of Texas. Jour. Myc. **13**: 102–114. 1907.

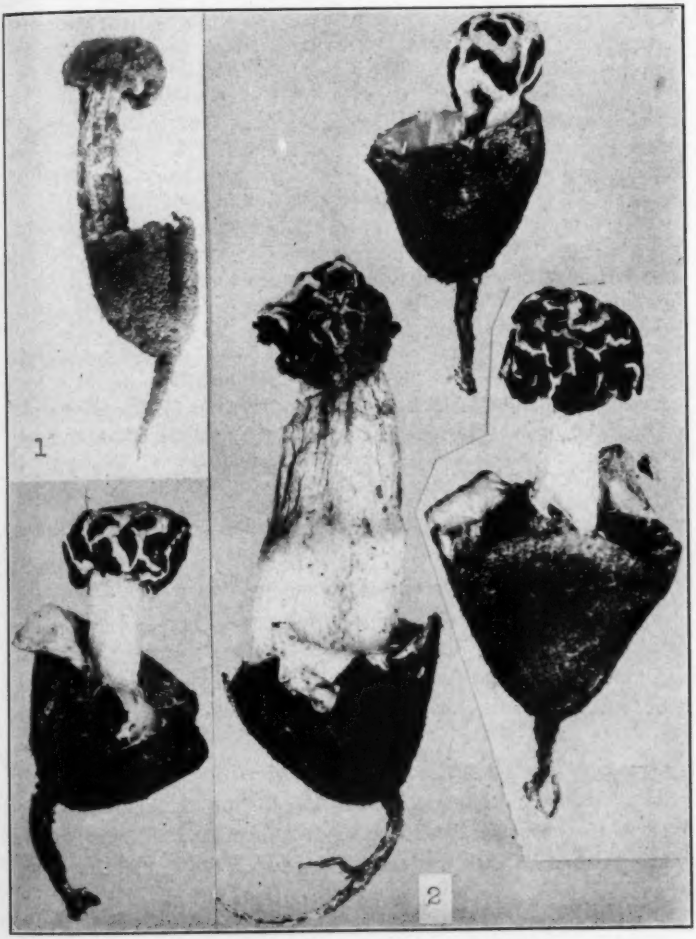

FIG. 1. *Simblum texense* var. *albidum* × 1.

some roots 5 cm. long, woody brown to buffy brown,[2] originating 1–3 inches below the surface of the soil, when mature and elongated consisting of a volva, stipe and cap (receptacle). *Volva* circumscissle (FIG. 1), upper part borne on cap when plant elongates

[2] All colors used are after Ridgway, R. Color Standards and Color Nomenclature. 1912.

in the field, cup-like, tough, inflated, woody brown, furfuraceous with minute hyaline hyphae which bind grains of sand firmly to its outer surface. *Stipe* 4–8 cm. tall by 1–1.5 cm. thick, terete or flattened, often fluted or furrowed, hollow, white inside and out, walls composed of 2–3 layers of chambers, 1–2 mm. thick; *chambers* often opening either inwardly or outwardly, 1–2 layers of cells thick at top and 2–3 cells thick at base of stipe, each cell about 2 mm. in diameter by 4 mm. long, cells irregularly polygonal, 4–5 sided. *Cap or receptacle,* depressed-hemispheric to irregularly globose (FIG. 1, 2), 1–2 cm. across by 1–1½ cm. tall, composed of very irregular, more or less isodiametric or oblong meshes, 4–6 mm. in diameter, 12–24 in number, the outer row of meshes usually free from the stipe at its outer and lower margin, bars white, not transversely rugose (FIG. 2), just a thin membrane. *Gleba* when fresh greyish olive to buff olive, having a pleasant amyl acetate odor, becoming hard and black within 24 hours after plant elongates, deliquescing after rains and then foetid. *Spores* subglobose, oval to pyriform, 2.8–3.5 × 4.2–5.6 microns, usual size 3 × 5 microns, walls rather thick, hyaline, smooth.

HABITAT: Solitary in sandy-adobe alkaline soil in open grassy areas, in semi-arid regions.

DISTRIBUTION: New Mexico, Bernalillo County near Albuquerque, elevation 5000 feet, *W. H. Long.* June 1, 1941, *31 plants* no. 9333. *Type;* June 9, 1941, *18 plants* no. 9348. Sandoval County, 5½ miles west of San Ysidro on State Highway 44, elevation 6250 feet, *W. H. Long.* July 9, 1941, *1 plant* no. 9378. A total of 50 plants.

A comparison of the description here given for *Simblum texense* var. *albidum* with that of *S. texense* will show the similarities as well as the differences between the two plants. The main difference is the white stipe and the white bars of the receptacle, not a trace of yellow is found in any of the 50 plants collected, also the color and surface of the eggs are not the same. *S. texense* has a yellowish white nearly smooth surface while the variety, *S. texense* var. *albidum* has a snuff brown, furfuraceous surface covered with grains of adhering sand. There are minor differences in the structure of the stipe and spore characters.

Figure 1, photographed after the specimen dried, shows a plant that elongated in the field, note that the cap does not show any generic characters, this is the usual condition of all plants that ex-

pand in the open; while figure 2 illustrates 4 plants that were collected in the egg stage and placed in a damp chamber until they elongated, these clearly show the *Simblum* characters. The large plant seen in the middle was photographed several days after it had elongated and had begun to dry out. This plant had a flattened, fluted stem consisting of 3 separate internal cylinders or tubes, each with its own individual walls but covered outside with a common wall as seen in the photograph.

This white *Simblum* was discovered within 100 yards of the writer's home where he has lived for 4 years, yet none were found till this year when the excessive precipitation kept the normally dry soil damp long enough for the plants to develop to maturity.

ALBUQUERQUE, NEW MEXICO

CLAMP-CONNECTIONS IN THE TREMELLALES

G. W. Martin

There seems to be a general impression that clamp-connections, if not lacking, are at least of rare occurrence in the Tremellales. The presence of such structures in *Phleogena faginea* was one of the considerations which led Shear and Dodge (**30**) to suggest that that species might be regarded as a protogasteromycete, related to *Tulostoma*. Very recently, Buller (**9**), in his stimulating discussion of the diploidisation process, has suggested that in these forms "clamp-connections may not often be present." Justification for such a suggestion may be found in the fact that many of the best-known accounts of the groups involved make no mention of their occurrence, and the references that do occur are scattered, largely in taxonomic papers, frequently doubtful and sometimes inaccurate. Nevertheless, many such references occur and a partial summary may be useful at this time.

As early as 1872, the Tulasnes (**31**) pictured unmistakable clamp-connections in *Guepinia Peziza* (*Guepiniopsis tortus*) and *Pilacre Petersii* (*Phleogena faginea*) and what strongly suggest them in *Hypochnus purpureus* (*Helicobasidium purpureum*). Brefeld (**8**) also illustrated them in *Phleogena,* which, of course, is not gelatinous, but in none of the other tremellaceous forms which he studied, although they are actually present in most of these, and very conspicuous in some. Möller (**22**) showed them clearly in four Brazilian species. Of 129 species mentioned by Bourdot and Galzin (**4**) the presence of clamp-connections is noted in forty-two. Of fifteen valid species of *Tulasnella* and *Gloeotulasnella* recognized by Rogers (**26**), clamp-connections are reported as occurring regularly or occasionally in seven. Brasfield (**5, 6, 7**) records their occurrence in a number of species of the Dacrymycetaceae. Neuhoff (**23**) has thus far treated fifteen species of Tremellaceae in his comprehensive monograph of the group: all are noted as having clamp-

connections. McGuire (**13**) recognized twenty-five species of *Sebacina*. Sixteen have clamp-connections; five apparently do not; in four they are not mentioned but it is possible that they occur in at least some of these. Since 1932 I have myself noted and illustrated such structures in a number of species. Numerous other references to them are to be found scattered through the literature.

In some species the clamp-connections are admittedly difficult to see. They are apt to be indistinct in forms with strongly agglutinated hyphae, such as those belonging to the section *Bourdotia* of *Sebacina*. In soft, gelatinous fructifications, such as those of certain of the Dacrymycetaceae, they are often distorted, especially in old basidiocarps; and even in the younger ones they may be more or less modified by the thick, gelatinous walls of the hyphae. Similar distortions occur in the genus *Auricularia*. On some hyphae they are entirely typical and may readily be seen in good mounts, but good mounts of the tough, rubbery pileus of the members of this genus are not easy to prepare. There remain, however, numerous species in which clamp-connections are easily observed in almost any mount.

The hyphae of many other tremellaceous fungi are often highly irregular and various kinds of enlargements as well as structures resembling false clamp-connections are commonly seen. Barnett (**2**) reported clamp-connections in four species, but unfortunately his drawings might be interpreted as representing false clamps. However, since unmistakable clamp-connections may be found in all four species, there is no reason to doubt the correctness of his report. Rogers (**29**) demonstrated the close relation between the clamp-connection at the base of the basidium and basidial proliferation in *Sebacina prolifera* and emphasized the striking similarity of this process with the development of clusters of asci through proliferation of the croziers. McGuire (**13**) pictures similar structures in other species of *Sebacina* and I have frequently seen them myself in various species of *Exidia* and *Tremella*.

It seems certain that some species never bear clamp-connections. The tough, fleshy species of *Sebacina*, represented by *S. incrustans* and *S. helvelloides*, lack them. Occasional references to their presence must be regarded as based upon inaccurate observation.

Closely related to such species are the members of the genus *Tremellodendron*, which also seem consistently to lack them (**3**). The very large genus *Septobasidium* (**11**) appears not to have them. Bourdot and Galzin (**4**, p. 7) report them as rarely present in *S. Bagliettioanum*, but this cannot be accepted without verification, especially as some species of *Septobasidium* are characterized by knobs on some of the hyphae which might easily be mistaken for clamp-connections. The species of *Septobasidium* are highly specialized parasites on scale insects, and it is perhaps significant that in *Eocronartium* and *Jola*, parasitic on mosses, and in the auriculariaceous parasite on *Cornus* and *Lonicera*, which is the unnamed perfect stage of *Glomerularia Corni* Peck, clamp-connections are also lacking. In *Sebacina* as a whole, as in most of the remaining genera, their presence seems to be the rule and their absence the exception.

In view of the chaotic taxonomy and involved synonymy of the Tremellales, any attempt to compile a complete list of species in which clamp-connections have been reported would be premature, especially as some authors report them as lacking in species in which others record them as present. Bourdot and Galzin, for example, report them as absent in *Phleogena faginea*, although they had been seen and illustrated by the Tulasnes, Brefeld, and Shear and Dodge, and are so conspicuous that they can scarcely be overlooked in a very casual examination. Such instances could be multiplied many times were it worth while. The following partial list, which includes many of the commoner species of temperate North America and such tropical American species as seem deserving of inclusion, may serve to give a fair idea of the relative abundance of clamp-connections in the order. Of the seventy-nine species listed, seventy-one have previously been reported as possessing clamp-connections. For the remaining eight, indicated in bold-faced type, this is, so far as I am aware, the first report.

TULASNELLACEAE

Gloeotulasnella cystidiophora Höhnel & Lits. (**4, 25, 26**), *metachroa* Bourdot & Galzin (**4, 26**), *pinicola* (Bres.) Rogers (**4, 26**), *traumatica* (Bourdot & Galzin) Rogers (**4, 26**).

Tulasnella allantospora Wakef. & Pears. (**26**), *araneosa* Bourdot & Galzin (**26**), *bifrons* Bourdot & Galzin (**4**), *rutilans* (Johan-Ols.) Bres. (**26**).

DACRYMYCETACEAE

Arrhytidia enata (Berk. & Curt.) Coker (**5**), *involuta* (Schw.) Coker (**5, 6**).

Calocera macrospora Brasf. (**6**).

Ceracea canadensis Jacks. & Mart. (**21**), *crustulina* Bourdot & Galzin (**4, 7**).

Dacrymyces deliquescens Duby (**5**), *Ellisii* Coker (**5**), *ganglii-formis* Brasf. (**7**), *palmatus* (Schw.) Bres. (**5**), *punctiformis* Neuh. (**5**).

Femsjonia luteo-alba Fries (**4, 5, 24**).

Guepiniopsis alpinus (Tracy & Earle) Brasf. (**5, 14**), *chryso-comus* (Tul.) Brasf. (**4, 5, 24**), *tortus* (Fries) Pat. (**5, 14**).

SIROBASIDIACEAE

Sirobasidium Brefeldianum Möll. (**22**), *sanguineum* Lag. & Pat. (**10, 17**).

TREMELLACEAE

Eichleriella **Leveilliana** (Berk. & Curt.) Burt, **pulvinata** Coker, *spinulosa* (Berk. & Curt.) Burt (**4**).

Exidia candida Lloyd (**10**), *glandulosa* Fries (**2, 4, 23, 24, 33**), *nucleata* (Schw.) Burt (**4, 23, 24, 33**), *recisa* Fries (**2, 4, 33**), *saccharina* Fries (**2, 23, 24, 33**).

Patouillardina cinerea Bres. (**16**).

Phlogiotis Helvelloides (Fries) Mart. (**23**).

Protohydnum **cartilagineum** Möll.

Sebacina adusta Burt (**13**), *atra* McGuire (**13**), *calcea* (Pers.) Bres. (**12, 13, 34**), *calospora* Bourdot & Galzin (**4, 13**), *cinerea* Bres. (**13, 27**), *fugasissima* Bourdot & Galzin (**13**), *Galzinii* Bres. (**13, 28**), *molybdea* McGuire (**13**), *opalea* Bourdot & Galzin (**13**), *Pini* Jacks. & Mart. (**13, 21**), *podlachica* Bres. (**13**), *plumbescens*

Burt (13), *prolifera* Rogers (13, 29), *rimosa* Jacks. & Mart. (13, 21), *sublilacina* Mart. (13), *umbrina* Rogers (13, 28).

Seismosarca **alba** Lloyd, *hydrophora* Cooke (17).

Stypella minor Möll. (15).

Tremella **atrovirens** (Fries) Sacc., *aurantia* Schw. (27), *compacta* Möll. (22), *foliacea* Fries (4), *frondosa* Fries (4, 32), *lutescens* Fries (4, 22), *mesenterica* Fries (4, 32), *mycophaga* Mart. (21), *subanomala* Coker (27).

Tremellodon gelatinosum (Pers.) Fries (4).

HYALORIACEAE

Hyaloria Pilacre Möll. (19).

PHLEOGENACEAE

Phleogena faginea Link (8, 24, 30, 31).

AURICULARIACEAE

Auricularia Auricula-Judae (Fries) Schroet. (2), **delicata** (Fries) P. Henn., *mesenterica* Pers. (12), **polytricha** (Mont.) Sacc., **rosea** Burt.

Cystobasidium sebaceum Mart. & Couch (20).

Helicobasidium candidum Mart. (21).

Helicogloea Lagerheimi Pat. (1), *pinicola* (Bourdot & Galzin) Baker (4).

Platygloea fusco-atra Jacks. & Mart. (21), *Peniophorae* Bourdot & Galzin (21).

Stypinella orthobasidion Möll. (22).

Syzygospora alba Mart. (18).

SUMMARY

Seventy-nine species of tremellaceous fungi, all occurring in the western hemisphere and representing all families except the Septobasidiaceae, are recorded as possessing clamp-connections. Such structures have previously been noted in seventy-one of the species listed.

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NON-VALIDITY OF THE GENUS ASPOROMYCES [1]

E. M. Mrak, H. J. Phaff and B. L. Smith

The imperfect yeast genus *Asporomyces* includes a single species, *A. asporus* described by Chaborski (**1919**). The essential points of the generic description given by Chaborski are as follows: The cells attempt conjugation by the formation of abortive conjugation tubes although ascospores are not formed. The species is characterized by fermenting glucose, sucrose, raffinose, maltose and inulin but not galactose, lactose, dextrin or soluble starch. This organism unfortunately was lost and hence has not been available for comparison with subsequently isolated cultures. In view of this Ciferri and Redaelli (**1929**) tentatively retained the genus in their treatment of the family Torulopsidaceae. They stated, "We reserve our final judgment until such time as we shall have been able to study this species directly in culture. Until then, we think it best to include it among the Torulopsidaceae, subfamily Torulopsideae because normally it has no mycelium." Lodder (**1934**) also retained the genus tentatively and made provision for it in her key of genera of the subfamily Torulopsoideae as follows:

> "Auf Gorodkowa-agar Bildung von eigentümlichen Schläuchen, den Kopulationsausläufern der *Zygosaccharomyces*-arten sehr änhlich ..... *Asporomyces* Chaborski."

Mrak and McClung (**1940**) isolated two nonsporulating yeasts forming abortive conjugation tubes, and, in accordance with the key of Lodder, included them in the genus *Asporomyces*. Since the specific characteristics differed from those of *A. asporus* the cultures were described as *A. uvae* a new species. A culture of this organism, sent to the "Centraalbureau voor Schimmelcultures," was examined by Dr. T. Hof who subsequently expressed the view, in a personal communication, that the culture is similar to

[1] Part of non-technical assistance supplied by W. P. A. Official Project 65-1-98-91—Unit B-5.

Torulopsis pulcherrima and should not be included in the genus *Asporomyces*. This view is supported by the observations of Windisch (**1938**) and Porchet (**1938**) who found that certain strains of *T. pulcherrima* produce abortive conjugation tubes and at times even form sterile dumbbells. The writers have also made similar observations with strains of *T. pulcherrima*. If the key given by Lodder was followed in the classification of these strains, *T. pulcherrima* would fall into the genus *Asporomyces* and if the genus is acceptable should be included therein. On the other hand, if the formation of abortive conjugation tubes is widespread in the imperfect yeasts, the genus *Asporomyces* can hardly be considered acceptable and its use should be discontinued.

In order to determine the extent of abortive tube formation in the imperfect yeasts several cultures were inoculated on carrot, potato and beet wedges and Gorodkowa agar slants for periodic examination. Those forming conjugation tubes or dumbbells or both were: *Torulopsis pulcherrima* (8 cultures); *T. lipofera, T. californicus, T. luteola, T. kefir* (2 cultures); *T. dattila, T. utilis, T. dactylifera, Torula rosea* (American Type Culture Collection No. *4055*) and *Candida tropicalis*. Those failing to form tubes or dumbbells after 6 months were, *Torulopsis pulcherrima* (8 cultures), *T. fermentans, T. lactosa, T. alactosa, Torula monosa* (*Candida monosa*) and *Rhodotorula rubra*.

Sporulating yeasts have also been observed to form abortive conjugation tubes occasionally on various sporulation media. A few examples are: *Zygosaccharomyces sp. R.* (from Japan), on potato, *Z. priorianus* on Gorodkowa agar, *Z. mandshuricus* on beet, *Debaryomyces Guilliermondii* (2 cultures) on beet and potato, *Saccharomyces* (Jerez strain, 4 cultures) on potato, *Pichia* sp. and *Schwanniomyces occidentalis* (2 cultures) on potato and beet. These organisms could easily have been classified as species of *Asporomyces* since in most instances sporulation was sparse or absent on the medium on which abortive conjugation tubes were observed.

The observations discussed above indicate that the formation of abortive conjugation tubes is not restricted to a single genus or family of yeast. It has been seen frequently, although it does not appear to occur with any regularity or under a given set of condi-

tions indicating that tube formation is not a reliable morphological character. In view of these circumstances it is concluded that abortive tube formation cannot be used to differentiate a genus and therefore the genus *Asporomyces* is no longer acceptable even in a tentative manner. *Asporomyces uvae* should be emended to *Torulopsis pulcherrima* as suggested by Hof. The true identity of *Asporomyces asporus* will probably remain in doubt although its fermentation characters are similar to those of *T. californicus*.

The key for the subfamily Torulopsidoideae as given by Lodder (**1934**) must be revised to omit the genus *Asporomyces* as given below:

KEY FOR THE GENERA OF THE SUBFAMILY TORULOPSIDOIDEAE

1. a. Cells predominantly apiculate, bipolar budding.....*Kloeckera* Janke
   b. Cells predominantly triangular, budding at the corners
   Trigonopsis Schachner
   c. Cells predominantly flask shaped, budding frequently on a broad base
   Pityrosporum Sabouraud
   d. Cells different, mostly spherical, oval or cylindrical .....(2)
2. a. No pellicle on liquid wort or a moist, somewhat slimy pellicle after prolonged standing .....*Torulopsis* Berlese
   b. In wort a dull dry pellicle forms rapidly .....(3)
3. a. Cells frequently cylindrical. Reproduction by budding, the buds are not separated from the mother cell by fission
   Mycoderma Persoon emend. Leberle
   b. Cells polymorphic, reproduction by budding. The buds are frequently separated from the mother cell by fission....*Schizoblastosporion* Ciferri

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PTYCHOGASTER CUBENSIS, A WOOD-DECAYING FUNGUS OF SOUTHERN OAKS AND WAXMYRTLE

Ross W. Davidson, W. A. Campbell, and George F. Weber

(with 3 figures)

Routine isolations from decay in living hardwoods occasionally reveal the presence of fungi not previously known to invade living trees. The decay fungi may be species that fruit commonly on old logs or stumps, as *Stereum gausapatum* Fries in oaks and *Polyporus glomeratus* Peck in maple, or little known fungi such as *Poria Andersonii* (Ellis & Ev.) Neum. and *Polyporus compactus* Overh. in oaks. Identification of cultures of the former group do not present such a difficult problem since it is usually possible to obtain sporophore cultures for comparison, but cultures of the latter group are much more difficult to identify. However, the identity of an isolate is sometimes suggested through comparisons of some microscopic features of the culture with described characteristics of sporophores. For instance, Overholts (**6**) described the context of *P. compactus* as composed largely of hyaline chlamydospores, whereas the most distinguishing characteristic of cultures of this fungus are the conspicuous masses of similar chlamydospores. The identities of cultures of *Poria Andersonii* and *Polyporus glomeratus* were first suspected by the presence of abundant hyphal setae which are conspicuous in sporophores of these species (**1**).

In 1935 Hepting (**2**) referred to 60 unidentified isolates obtained in a decay study in Mississippi Delta hardwoods. Among these was a culture from decay in the heartwood of willow oak (*Quercus phellos* L.) that formed abundant brown conidia. Another culture of what appeared to be the same fungus species was isolated in 1938 from heartwood of a living water oak (*Q. nigra* L.) from Florida. At that time a careful search of the literature disclosed the fact that brown conidia described by Patouillard (**7**, p. 133)

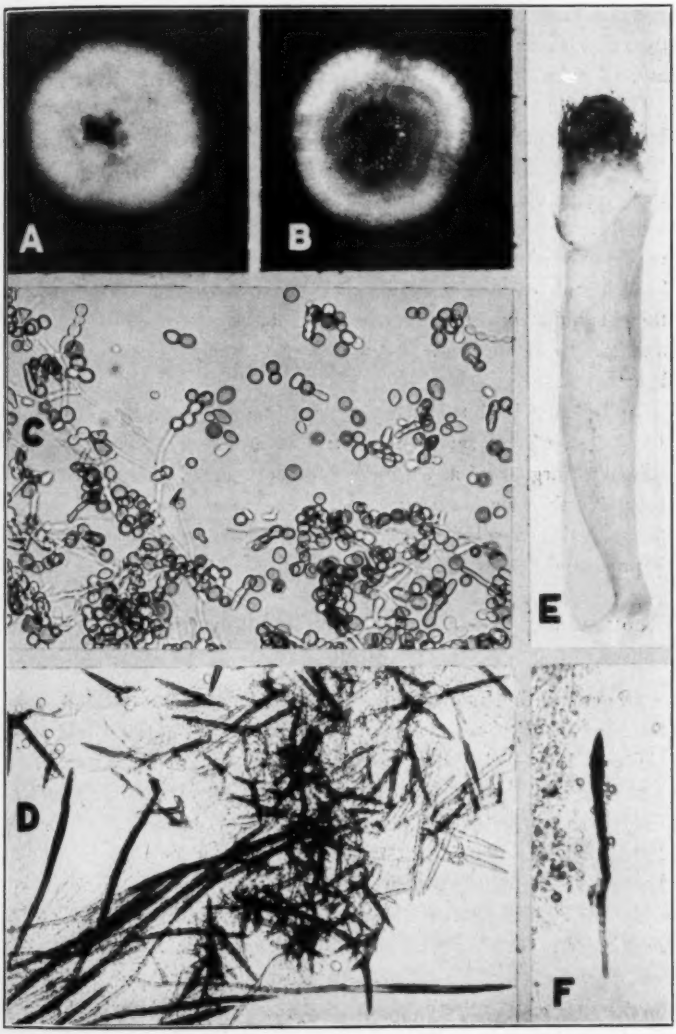

FIG. 1. *A–E, Ptychogaster cubensis* Pat. from southern hosts: *A*, 14-day-old culture from oak; *B*, 14-day-old culture from southern waxmyrtle; *C*, photomicrograph of conidia from a pure culture, × 250; *D*, photomicrograph of large and small setae from a pure culture, × 250; *E*, spore mass formed at upper margin of malt agar slant-culture; *F*, setal-hypha and conidia from *Polyporus Rickii* (Pat.) Sacc. & Trott. collected in Peru.

for the fungus *Ptychogaster cubensis* Pat. were very similar to those in cultures of the fungus from oak heartwood from Louisiana and Florida.

The following year (**1939**) a fungus composed of masses of brown conidia was collected on the trunk of turkey oak (*Quercus Catesbaei* Michx.) and on the stump of the *Q. nigra* from which the Florida culture had been obtained, and what seemed to be the same fungus was found in Florida on numerous living stems of southern waxmyrtle (*Myrica cerifera* L.) in association with dead branch stubs or wounds and decay. Cultures from decay back of these conidial masses indicated the fungi on southern waxmyrtle and oak to be the same as the one previously isolated from oak heartwood.

In January 1941 this same conidial stage was again collected in Florida on a living sand live oak tree (*Quercus virginiana geminata* (Small) Sarg.) and as a fungus of this type has not been reported from North America before and, since it seemed to be of importance as the cause of decay in living trees, a preliminary account is presented at this time.

COMPARISON WITH DESCRIPTIONS AND HERBARIUM SPECIMENS OF PTYCHOGASTER

In general the fungus from Florida and Louisiana appears to be the same as *Ptychogaster cubensis* Pat. that was described from Cuba in 1896 (**7**) and the conidial stage of *Xanthochrous Rickii* Pat. collected by Rick in Brazil (**8**, p. 6) and later referred to *Polyporus Rickii* (Pat.) Sacc. & Trott. (**10**, p. 270). However, Patouillard described *P. cubensis* as having a somewhat more compact structure than is shown in the Florida specimens.

In 1915 Lloyd (**3**) called attention to the similarity of *Polyporus Rickii* to *P. glomeratus,* presumably from a similarity in appearance and in presence of imbedded setae in both, and suggested *Ptychogaster cubensis* as being the same thing. Lloyd further states, "I hardly feel that the subject is much cleared up by the publication of such species." However, in 1917 (**4**) he described *Ptychogaster lucidus* from a specimen collected by Rev. C. Torrend in Brazil. It was growing from or in very close association with a

normal sporophore of *Polyporus lucidus*. In compact structure and spore character the conidial part of this specimen is very similar to that described for *P. cubensis*.

SPECIMENS EXAMINED

The Mycological Collections of the Bureau of Plant Industry, U. S. Department of Agriculture, contain a number of *Ptychogaster* specimens among which are those mentioned by Lloyd:[1]

Polyporus Rickii Pat. *133* (C.G.L. Cat. No. *18854*) "ex type." This is only a fragment of rather compact tissue containing a few conidia similar to *P. cubensis* and large setal hyphae but no evidence of pores.

Ptychogaster Fici Pat. (C.G.L. Cat. No. *58824*) "ex type." There is no other data with this specimen but it has conidia similar to *P. cubensis*.

"*Ptychogaster lucidus* Lloyd." "Type" from Rev. C. Torrend, Bahia, Brazil (C.G.L. Cat. No. *55501*). This specimen consisted of what appears to be a distorted sporophore of *P. lucidus* and a globose *Ptychogaster* with compact zoned structure similar to that described by Patouillard for *P. cubensis* and abundant brown conidia and large setal hyphae. These two specimens are not now connected. There seem to be very few if any spores of the *Ptychogaster* in the tissue of the *Polyporus*.

A most interesting specimen was one identified as *Polyporus Rickii*, collected at Lima, Peru, on a fruit tree October 13, 1917, by J. R. Weir (C.G.L. Cat. No. *18866* and No. *9367* ex. herb. J. R. Weir). This specimen consists of a somewhat globose mass of context tissue with a radiating zonate structure and filled with abundant conidia similar to those described for *Ptychogaster cubensis*. From the under side of the outer margin and arising directly from the mass of context tissue are coarse brown pores about 1 cm. in length. Conspicuous, large, brown setal hyphae are present in the tramal tissue of these pores (FIG. 1, *F*).

Ptychogaster sp. (C.G.L. Cat. No. *55504*). Collected by L. J. K. Brace, Nassau, Bahamas. This is a *Polyporus* with imbricate

[1] The authors acknowledge the assistance of J. A. Stevenson in examination of valuable specimens in the C. G. Lloyd Herbarium and in the Mycological Collections of the Bureau of Plant Industry.

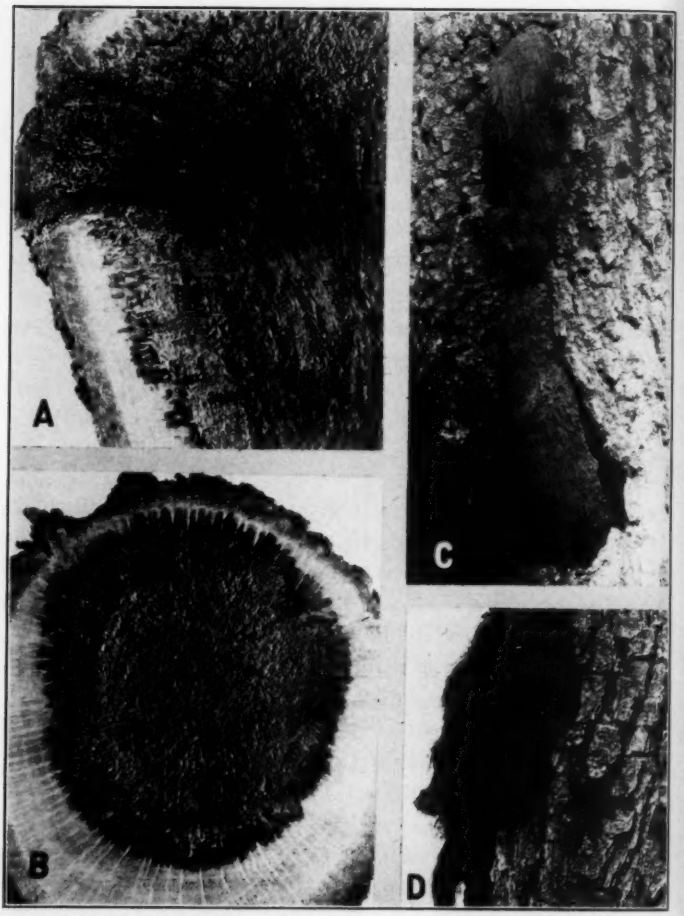

FIG. 2. *A–D, Ptychogaster cubensis* Pat. on southern oaks: *A*, longitudinal section through a stem showing decay advancing into sapwood area and sterile mass of fungus tissue formed at a branch stub; *B*, cross section of the same stem; *C* and *D*, conidial fruiting masses.

pilei, 5 inches broad and about 1 inch thick at base to ⅛ inch thick at margin, surface covered with dark red-brown ("chestnut" to "russett" [2]) dusty mass of conidia; context corky, light brown

[2] All colors in quotation marks are from Ridgway (9).

("clay color"); pores mostly 1 cm. long but much shorter at margin of pilei; mostly filled with masses of light brown, broadly ovoid ($7 \times 5\ \mu$) basidiospores, mouths of pores closed by a layer of the dark red-brown conidia. Freehand sections disclosed the context tissue also contained numerous hyaline to light brown conidia interspersed with the brown mycelium. Except for their lighter color the context conidia were similar to those on the surface of the sporophore. The hymenium contained four-spored globose basidia and a few small setae projecting about 25 μ. Large setal hyphae were abundant in the tramal tissue with their points sometimes projecting through the hymenium at an acute angle.

This and the Weir specimen from Lima, Peru, are somewhat similar although this Brace specimen is in much better condition and, as indicated by presence of basidia and spores, was probably in active sporulating condition when collected. The pores of the Peru specimen contained what appeared to be a few light brown basidiospores but no basidia. These were the only two specimens seen that definitely indicate that a conidial fungus similar to that described for *Ptychogaster cubensis* has a basidial stage belonging to the genus *Polyporus*.

Ptychogaster sp. (C.G.L. Cat. No. *55503*) collected by L. J. K. Brace, Nassau, Bahamas, 1916. The specimen is now just a loose mass of dark brown spores, but a letter from Brace states, "Like a light brown cake in its rounded top shape, about 4 inches wide and 2 inches high growing on side of citrus tree which is decaying . . . golden orange, reddish. . . ."

Ptychogaster sp. (C.G.L. Cat. No. *25150* and No. *23*). From S. R. Bose, Calcutta, India. This specimen was fairly compact and with radiating structure but is now broken up. A few setal hyphae were found in the mass of spores.

Ptychogaster sp. (C.G.L. Cat. No. *19990* and No. *11*). From S. R. Bose, Calcutta, India. "Growing on side of tree trunk. Hymenial surface yellow sometimes dark yellow. General color deep brown with yellow tinge on upper surface." This specimen is rather compact with no pores or hymenial surface evident at this time.

Ptychogaster sp. (C.G.L. Cat. No. *50545* and No. *25144*). From J. Rick, Brazil. This specimen has a fairly compact radiating structure.

Ptychogaster sp. (C. L. Shear No. *835*) from Waipio ridge, Oahu, T. H., on stem of *Acacia koa* A. Gray, March 3, 1928.

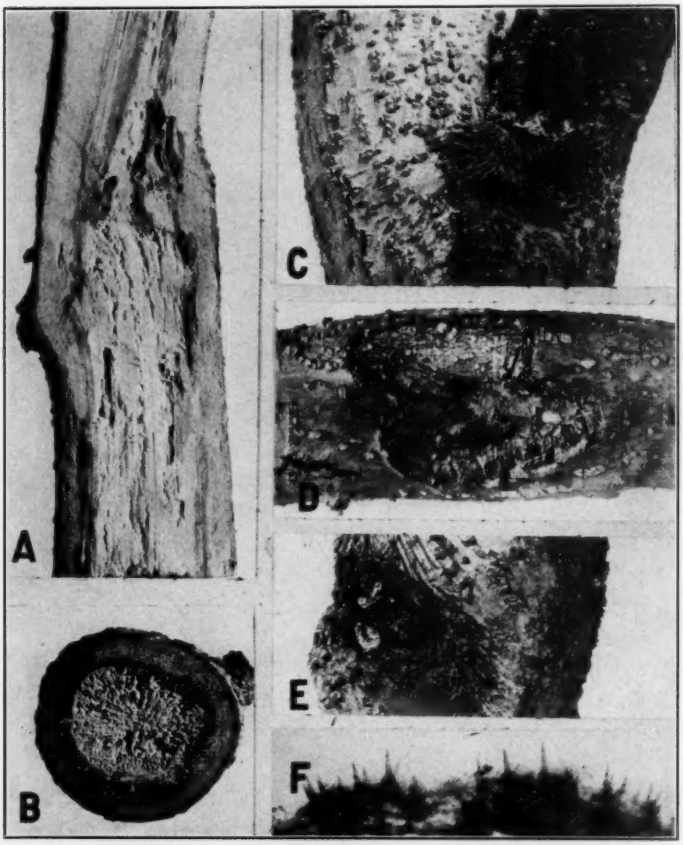

FIG. 3. *A–F, Ptychogaster cubensis* Pat. on southern waxmyrtle (*Myrica cerifera* L.): *A* and *B*, sections through infected stems showing decay; *C*, conidial fruiting at the base of a dead branch; *D*, layer of fungus growth over old injury; *E*, hard sterile mass formed on stem at branch stub trace; *F*, photomicrograph of section from fungus layer in *D* showing setae projecting from surface.

This specimen consists of a loose mass of spores and fungus strands which is similar to specimens from Florida.

Ptychogaster sp. Collected by V. K. Charles in Haiti, March 1921, on very large trunk of living *Tamarindus indica* L. Miss Charles states that this was a large powdery mass of spores, 1 to 2 feet across, about 8 to 10 feet up on the trunk.

Ptychogaster sp. (Plants of Haiti No. *11439*) collected by E. C. and G. M. Leonard, January 1, 1929, from base of tree near shore, vicinity of La Vallée, Tortue Island, Haiti. This specimen consists of a compact, radial, zonate mass of hyphal strands and spores with hard covering of mycelial tissue. Setal hyphae were also observed in microscope mounts.

All of the above specimens contain conidia that are similar in size and color to those of the fungus from Florida and Louisiana, but some of them are more compact in structure and several have a firm covering layer not observed for any of the Florida specimens.

The presence of *Polyporus lucidus* attached to one specimen studied by Lloyd is probably the result of a close association of two organisms, but the *Polyporus* specimens from Peru and Bahamas and possibly the type of *P. Rickii* from Brazil, of which only a fragment was seen, indicate that the basidial stage of *Ptychogaster cubensis*-like conidial fungi belongs in the genus *Polyporus*.

HOST RELATIONSHIP

Study and comparison of cultures from decay in oaks and from decay in southern waxmyrtle indicate that the fungus from these unrelated hosts belongs to the same species. It is reasonable to expect it to occur in numerous other hosts as indicated from collection records with some of the herbarium specimens already referred to.

In the few oak trees examined it was causing extensive white to yellow-brown decay in the heartwood and in at least one of these trees it was advancing into the sapwood (FIG. 2, *A* and *B*). In southern waxmyrtle it was causing white decay in the central area of the stems (FIG. 3, *B*), extending upward from 5 to 18 inches from the entrance point and downward about the same distance. About 24 infected stems were examined, ranging in diameter from

1½ to 2½ inches. Since these stems did not appear to have heartwood the fungus is probably parasitic, working upward through the older sapwood area and encroaching slowly on the outer sapwood (FIG. 3, *A*). Some of the infected stems had died but whether the decay fungus was responsible for this condition could not be determined. A number of the stems had enlarged dead areas at or near the point of infection. Infections were centered at dead branch stubs or injuries.

The conidial fruiting developed at branch stubs (FIG. 3, *C*), wounds, or directly through the bark of some of the dead stems (FIG. 2, *C* and *D*). The fungus had formed hard layers or masses of old mycelial tissue at many of the stubs (FIG. 2, *A*) and wound areas (FIG. 3, *D*). Several were hard, irregular, rough, thick knots of tissue (FIG. 3, *E*), resembling small sterile conks of *Polyporus glomeratus* or *Poria obliqua*, and a number were more uniform layers 1 to 2 mm. thick with many brown setae projecting from the surface (FIG. 3, *F*). The latter suggested old sporophores of *Hymenochaete* but there was no indication of a basidial layer. Brown conidia were sometimes present on or imbedded in these layers of fungus material.

In 1919 Murrill (**5**) reported collecting *Ptychogaster cubensis* in Cuba on "base of trunks" but names of the hosts were not given.

CONIDIAL FRUITING ON STEMS

There is great variation in extent and appearance of the conidial stage formed under natural conditions. On the oaks, the conidial mass was quite large (FIG. 2, *C* and *D*) but on southern wax-myrtle they were usually small (FIG. 3, *C*). Some of the conidial masses were fairly compact but most of them were loose and somewhat plumose. All of the larger conspicuous masses consisted of long strands of hyphae radiating outward and downward from a central point of attachment and surrounded with a mass of powdery, dark red-brown spores. The strands of hyphae were usually from ½ to 1½ inches in length and extended through the bark from the wood surface. None of the spore masses had any noticeable covering at the time they were examined in the laboratory.

The spores appear to form in chains from the radiating strands of hyphae, are variable in shape but usually globose, 8–13 μ in diameter, thick walled, and dark brown. Short or long setal hyphae are present in the mass of spores and hyphae.

THE FUNGUS IN CULTURE

Cultures of *Ptychogaster cubensis* were obtained from decayed wood and from hyphal strands of the conidial fruiting body. Attempts to germinate conidia were unsuccessful. Growth rate of several isolates was recorded for various constant temperatures in the dark. There was no growth at 10°, good growth at 30°, and no growth at 40° C. Inoculum held at 10° C. for 18 days grew when it was returned to room temperature but inoculum held at 40° C. for 18 days failed to grow when returned to room temperature.

Technical description: Growth slow, forming in 14 days a mat 2.5–5 cm. in diameter;[3] mat at first white, moderately raised, loose-cottony becoming in 7 to 14 days "cream color," "cinnamon buff," "gray buff" to as dark as "buckthorn brown" at the center or over most of mat and with a narrow or wide white marginal zone (FIG. 1, *A* and *B*); mat color dependent upon intensity of light and in weak illumination some isolations remain white or become only slightly "cream color" around the inoculum in 14 days; colored center somewhat compacted, often appressed, usually glistening from innumerable fine guttation drops; entire mat fragile, mostly azonate; margin proper white, even, cottony.

Test-tube cultures at first entirely white becoming in diffused light irregularly "cinnamon buff" and "buckthorn brown" on upper part of slant and on agar cylinder; setal hyphae form in abundance next to glass and appear as fine brown streaks that can be seen with the naked eye; cultures in dark remain white and if undisturbed for 4–6 weeks most isolates form a typical brown *Ptychogaster* mass of spores on upper part of slant (FIG. 1, *E*).

[3] Description based on mats grown in diffused light on 2 per cent Difco malt agar at room temperature of about 25° C.

Staining hyphae thin-walled 1–5 μ in diameter, with cross-walls but without clamps; non-staining yellowish hyphae found in brown portions of mat in connection with conidia formation; conidia very abundant, with staining content when immature, becoming brown when mature, often formed in chains, individual conidia globose, ovoid or irregular 5–10 μ in diameter (FIG. 1, *C*); setal hyphae abundant in some cultures, less common in others, opaque 5–12 μ in diameter; irregular short setae also common (FIG. 1, *D*).

SUMMARY AND CONCLUSIONS

A fungus tentatively identified as *Ptychogaster cubensis* Pat. was isolated from heartwood decay in *Quercus phellos* L. from Louisiana and *Q. nigra* L. and *Q. Catesbaei* Michx. from Florida and from decay in numerous living stems of *Myrica cerifera* L. in Florida. The conidial stage was collected on trunks of dead *Q. Catesbaei, Q. nigra,* and *M. cerifera,* and at branch stubs and injuries on living trunks of *M. cerifera* and *Q. virginiana geminata* (Small) Sarg.

Numerous herbarium specimens of *Ptychogaster* were examined which contained conidia of the same size and color as the fungus from Florida and Louisiana. All of these seem referable to *Ptychogaster cubensis* Pat. and were from Brazil, Peru, Territory of Hawaii, India, Haiti, and Bahamas. Whether or not these specimens represent one or several species will depend on comparison of cultures from various hosts in the above localities. The herbarium specimens from the Bahamas and Peru have pores developed in close association with the conidia, which indicates that the basidial stage of this type of decay fungus belongs to the genus *Polyporus.*

Cultures from the Florida and Louisiana specimens have been studied and described in detail. Conidia and setal hyphae similar to those formed in nature are abundant in the cultures studied.

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STUDIES IN THE GENUS HELOTIUM. I. A REVIEW OF THE SPECIES DESCRIBED BY PECK

W. Lawrence White [1]

(with 16 figures)

Not since Rehm some fifty years ago treated the Discomycetes of Germany, Austria, and Switzerland for Rabenhorst's Kryptogamen-Flora, and never for any part of the world other than Europe, has there been any attempt at a monograph of *Helotium* or even of any very closely allied genera. That genus (including *Phialea*) now embraces several hundred so-called species, many of them known only from the original description. Because the early types have not been restudied and the descriptions organized into a usable system—in general, because of a lack of literature for identification work—the non-specialist of today generally neglects even to collect such forms, for once having done so it is impossible to attach to them a name under which they may be preserved and studied. In the present writing, which is intended to represent a preliminary contribution toward a monograph of the genus, an effort is made to amplify Peck's original descriptions and to bring together in one paper all of the records, both of literature and herbarium specimens, that can be located representing species described by him and belonging in *Helotium*. An exception is *H. gracile*, a synonym for *H. scutula*, for which space is not available for as detailed a treatment as is given the less common forms. Taking into account the fact that Peck's names are now of some seventy to eighty years standing, one is much impressed at the slight extent to which they have come into circulation. The scantiness of the records is to be interpreted as an index to the amount of collecting and the extent of past work on fungi of this group, rather than to their actual occurrence and geographic distribution.

[1] Contributions from the Laboratories of Cryptogamic Botany and the Farlow Herbarium, Harvard University, no. 202.

During the forty-eight years, 1867 to 1915—mostly for the relatively brief period of 1874 to 1890—of his official connection with the New York State Museum, Peck described as new under the generic name *Helotium*, eighteen species. Of this number, eight will fall into the genus as it is understood at the present time and the remaining ten should be excluded. Of those eight species properly placed by Peck, his specific names remain valid for five. Of those excluded, one, *H. macrosporum*, has recently been transferred to its proper taxonomic position by Miss Kanouse with Peck's specific name valid; another, *H. thujinum*, appears in Seaver's North American Cup-Fungi as a synonym of an old European operculate species; two are known to the writer only from Peck's material; and six are here for the first time referred to synonymy under old, well-known European names. Peck's conception of *Helotium* was so broad that he erred less frequently in placing true members of that genus elsewhere. He did, however, describe three species in *Peziza*, one of which was transferred to *Helotium* by Saccardo, while the other two are transferred in the present paper; also, near the end of his career, in an apparent attempt to follow the Saccardoian system he described a *Phialea anomala* which the writer recently has reduced to synonymy under *Rutstroemia longipes*. Condensing certain of the foregoing data: out of a total of twenty-two species described by Peck—those he placed in *Helotium* plus those he should have placed there—eleven of his specific names may stand for the present, ten are out because of priority, and one is a homonym. In addition to his "new species" Peck listed a total of seven old European forms which he found in New York State. These are appended for the sake of completeness; all are of common occurrence in the state.

Peck's herbarium is excellently preserved at Albany. Type material of all the species of the present paper is there and in most cases the specimens are very ample for study. In some instances, however, where Peck collected a species more than once, difficulty was experienced in determining just which packet represented the type; and even more difficult was the problem of knowing which specimens at Albany were represented by the portions of specimens found in other herbaria.

Only material actually studied is cited, and the herbarium in which the specimen examined is located is designated by an abbreviation in parentheses. The abbreviations used are those published by Dr. J. Lanjouw of the Commission for Urgent Taxonomic Needs of the International Botanical Congresses (Chronica Botanica **5**: 142–150. 1939), with an additional letter in some instances to denote herbarium subdivisions. They are as follows: CUP = General Herbarium of the Department of Plant Pathology, Cornell University; CUP–D = Durand Herbarium in the same department; FH = Farlow Herbarium; FH–E = Ellis Herbarium in the Farlow Herbarium; FH–H = von Höhnel Herbarium in the Farlow Herbarium; FH–P = Patouillard Herbarium in the Farlow Herbarium; NY = New York Botanical Garden; NYS = New York State Museum; OTB = Division of Botany, Central Experimental Farm, Ottawa.

HELOTIUM ALBUMINUM (Cooke & Peck) Saccardo, Syll. Fung. **8**: 214. 1889.

Peziza albumina Cooke & Peck, *in* Peck, Ann. Rep. N. Y. State Mus. **26** (1872): 81. (June) 1874; Cooke, Bull. Buffalo Soc. Nat. Sci. **2**: 294. 1875; Cooke, Grevillea **4**: 132. *pl. 65, fig. 283.* 1876; Peck, Bull. Buffalo Soc. **4**: 219 (155). 1883.

Calycina albumina (Cooke & Peck) Kuntze, Rev. Gen. Pl. 3^2: 448. 1898.

FIG. 5

Apothecia solitary or more often gregarious, sometimes crowded and showing a slight tendency to become confluent, pale yellow when dry and more or less concolorous throughout; **stipe** papilla-like or slender, cylindric, and distinct; **disc** opening by a pore, expanding and becoming nearly plane, in the dried condition thin, rather deeply concave, often slightly contorted, reaching a diameter of 0.4–0.6 mm., rarely up to 0.9 mm.; **receptacle** well elevated above the substratum, entirely free even when the stipe is nearly lacking, when dry cream-colored to buff or pale ochraceous, under the lower powers of the microscope appearing very finely striolate or white-puberulent; **margin** thin, turned inward in dried material so as to partially obscure the hymenium, circular or lobed; **hymenium** waxy in dried material, concolorous with receptacle or yellowish, often varying toward citron; **paraphyses** simple, scarcely or not

at all enlarged at apex, about 2 μ diam.; **asci** cylindric above; subtruncate, slightly narrowed below to a broad basal portion, 42–55 × 5 μ; **ascospores** biseriate, 1-celled, allantoid, 7–9 × 1.2–1.8 μ.

On dead wood and bark of frondose trees, recorded by collectors on quince?, *Acer* sp., and undetermined species; in one case an erumpent pyrenomycetous fungus is present and many apothecia very definitely are growing from its stromata.

Previously recorded only from New York on the basis of Peck's material. Specimens have been examined from New York, Michigan, Oregon, and Ontario.

Material examined: New York: The collection data on the Peck packets found in the various herbaria has been so inadequately and even incorrectly preserved that it is now not possible to determine with absolute certainty whether they represent one or more than one original collection, at least not without bringing together all portions in the same laboratory for careful comparison. Certainly they represent only one species. Each is cited as a separate collection with full data as it now appears on the label. *292. Peziza albumina* C. & P. On wood. N. Greenbush. Oct. *Type.* (NYS); Albany, N. Y. Oct. *C. H. Peck* (*292*). *Type.* (CUP–D *3739*); On wood. North Greenbush, N. Y. Oct. *Dr. Peck.* (CUP–D *5612*); Greenbush, N. Y. (NY); On *Acer.* Clyde. Feb. 1888. *O. F. Cooke* (*536*). As *Helotium albellum* (With.) Karst. (CUP–D *8394*). *Michigan:* Wheeler's woods, Ann Arbor. Oct. 29, 1931. *B. B. Kanouse.* (FH); *Oregon:* On quince bark? Hood River. Nov. 11, 1931. *J. R. Kienholz.* K12. (FH, NY); *Ontario:* Britannia. *11–9–03.* As *Helotium episphaericum* Pk.? (FH–E *44, 189–13*).

Two packets at Albany, apparently different collections and represented in the Durand Herbarium as Nos. *5613* and *5614,* all labelled *Peziza albumina* C. & P. followed by a question mark, are referable to *Helotium herbarum* (Pers. ex Fries) Fries. It very evidently was on one or both of these specimens that Peck based his second report, on "decaying wood and stems," after he previously had described the species from wood only. The Michigan specimen cited above, kindly furnished the writer by Dr. Kanouse, was reported by her (Papers Michigan Acad. **23** (1937): 152.

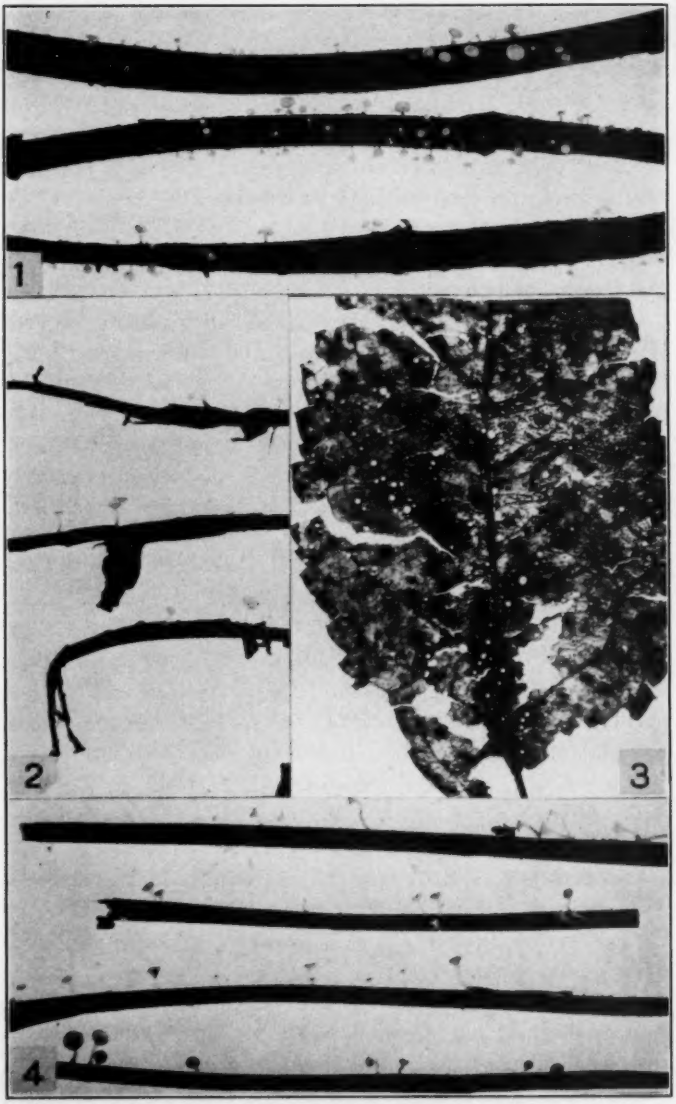

FIG. 1, *Helotium scutula*, apothecia on dead hop vines, × 2 (CUP *24907*); 2, *Helotium fastidiosum*, apothecia on old leaves and petioles of *Alnus incana*,

1938) as *Helotium limonium* Cooke & Peck, which is a similar and evidently closely allied species occurring on dead herbaceous stems. The distinctive characters of *H. albuminum* are the pale color, finely puberulent exterior, small allantoid spores, and occurrence on wood or bark of trees.

HELOTIUM SCUTULA (Persoon ex Fries) Karsten, Symb. Myc. Fenn. Not. pro Fauna et Fl. Fenn. **11**: 233. 1871; Myc. Fenn. Pars prima—Discomycetes. Bidr. Finl. Nat. Folk **19**: 110. 1871; Symb. Myc. Fenn. II. Not. pro Fauna et Fl. Fenn. **13**: 233. 1874; Patouillard, Tab. Anal. 38. *fig. 93 a–c.* 1883; Saccardo, Fungi Ital. *fig. 1340.* 1883; Rehm, *in* Rabh. Krypt.-Fl. 1^{a}: 771. *fig. 1–5.* 792. 1893; 1267. 1896; Massee, Brit. Fung. Fl. **4**: 253. 1895; Massee & Cr. Fung. Fl. Yorkshire 284. 1905; Boudier, Hist. Classif. 114. 1907; Migula, *in* Thomé Krypt.-Fl. **3**: 1199. *pl. 178, fig. 9–12.* 1913; Grove, Trans. Brit. Myc. Soc. **15**: 177. *illus.* 1930–31; Velenovský, Monogr. Discom. Boh. **1**: 193, **2**: *pl. 20, fig. 24, 25.* 1934.

Peziza scutula Pers. Myc. Eur. **1**: 284. 1822; Fries, Syst. **2**: 123. 1822; Summa Veg. Scand. 253. 1849; Fuckel, Symb. Myc. 308. 1869; Karsten, Monographia Pezizarum Fennicarum. Not. pro Fauna et Fl. Fennica **10**: 133. 1869.

Ciboria ciliatospora Fuckel, Symb. Myc. 311. *pl. 4, fig. 36.* 1869; Sacc. Syll. Fung. **8**: 205. 1889.

Helotium gracile Cooke & Peck, *in* Peck, Ann. Rep. N. Y. State Mus. **26** (1872): 83. (June) 1874; Cooke, Bull. Buffalo Soc. **2**: 299. 1875; Ellis, Cat. New Jersey Pl. 550. 1890.

Phialea scutula (Pers. ex Fries) Gill. Discom. Fr. 108. 1879; Sacc. Syll. Fung. **8**: 266. 1889; Bref. Unters. **10**: 323. 1891.

Helotium vitellinum Rehm, Ascom. Exsicc. fasc. XI, *513.* Ber. Nat. Ver. Augsburg **26**: 124. 1881; Boud. Hist. Classif. 113. 1907.

× 2 (CUP *24817*); 3, *Helotium naviculasporum*, apothecia on decaying leaf of *Prunus* (?), × 1 (CUP *25515*); 4, *Helotium fraternum*, apothecia on decaying petioles of *Acer spicatum*, × 2 (CUP *24820*).

Helotium virgultorum var. *scutula* (Pers. ex Fr.) Rehm, Ascom. Lojk. (Budapest) 7. 1882.

Calycella scutula (Pers. ex Fries) Quel. Enchr. Fung. 305. 1885.

Helotium scutula forma *Rubi* Rehm, Hedwigia **24**: 229. 1885; Rehm, *in* Rabh. Krypt.-Fl. 1^3: 794. 1893; Migula, *in* Thomé, Krypt.-Fl. **3**: 1200. 1913.

Hymenoscypha scutula (Pers. ex Fries) Phill. Brit. Discom. 136. 1887.

Hymenoscypha scutula var. *Lysmachiae* Phill. Brit. Discom. 138. 1887. (*Nom. nud.*).

Hymenoscypha scutula var. *Rudbeckiae* Phill. Brit. Discom. 138. 1887.

Phialea vitellina (Rehm) Sacc. Syll. Fung. **8**: 262. 1889.

Phialea gracilis (Cooke & Peck) Sacc. Syll. Fung. **8**: 265. 1889.

Phialea scutula var. *Rudbeckiae* (Phill.) Sacc. Syll. Fung. **8**: 266. 1889.

Helotium Verbenae Cavara, Rev. Myc. **11**: 178. *pl. 1, fig. 2 a–d.* 1889.

Phialea appendiculata Oud. Versl. Med. K. Ak. v. Wet. 3: **VII**: 313. *pl. 2, fig. 6–8.* 1890; Verh. Kon. Ak. Wet. Amst. 3: **XI**: 345. *illus.* 1904.

Belonioscypha ciliatospora (Fuckel) Rehm, *in* Rabh. Krypt.-Fl. 1^3: 744. 1893; see also p. 1267. 1896; Höhnel, Österr. Bot. Zeitschr. **54**: 15 (reprint?) 1904; Migula, *in* Thomé, Krypt.-Fl. **3**: 1190. *pl. 177, fig. 10–13.* 1913; Zeller, Mycologia **27**: 452. 1935.

Helotium scutula forma *vitellina* (Rehm) Rehm, *in* Rabh. Krypt.-Fl. 1^3: 794. 1893; Peck, Rep. N. Y. State Bot. **56**: 31. 1902; Migula, *in* Thomé, Krypt.-Fl. **3**: 1200. 1913.

Helotium scutula forma *Lysmachiae* (Phill.) Massee, Brit. Fung. Fl. **4**: 254. 1895.

Helotium scutula forma *Rudbeckiae* (Phill.) Massee, Brit. Fung. Fl. **4**: 254. 1895; Boud. Hist. Classif. 114. 1907.

Hymenoscyphus gracilis (Peck) Kuntze, Rev. Gen. Pl. **3**: 485. 1898.

Helotium vitellinum var. *pallido-striatum* Fairman, New Fungi from Western New York 231. 1904.

Phialea vitellina var. *pallido-striata* (Fairm.) Sacc. & Sacc. Syll. Fung. **18**: 56. 1906.

Helotium appendiculatum (Oud.) Boud. Hist. Classif. 114. 1907.

Helotium ciliatospora (Fuckel) Boud. Hist. Classif. 114. 1907; Wakefield, Trans. Brit. Myc. Soc. **6**: 132. 1919; Barnes, Brit. Myc. Soc. Trans. **18**: 76. *illus.* 1933.

Belospora ciliatospora (Fuckel) Clements, Gen. Fungi 175. 1909; Atkinson, Bot. Gaz. **49**: 151. 1910; Sacc. Syll. Fung. **24**^{2}: 1182. 1928. [Type of *Belospora* Clem.].

FIG. 1, 6 *a–c*

"Ochraceous; cups plane, then convex, immarginate, rather thin, externally slightly paler; stem slender, equal, brownish toward the base, about as long as the diameter of the cup; asci cylindrical; spores cylindric or subfusiform, obtuse at the extremities, two to three nucleate, .0007–.0008 in. long.

"Stems of herbs. Center. October.

"In size and habit it resembles *P. cyathoidea,* but the cups are never closed."

The above is a copy of Peck's description. Both Peck and Ellis made several collections which they referred to this species, though both recognized it as synonymous with *Helotium scutula* as is indicated by notes on their packets. The rather lengthy synonymy includes only names which seem beyond all doubt to belong there, several others are suspected but are withheld for the present for further study, and several varieties of the species are definitely distinct, some of them deserving of specific rank.

This is our common, yellow, stipitate species of *Helotium* found in mid- and late summer on all kinds of dead herbaceous stems; it is perhaps the commonest member of the genus in both North America and Europe. Abundant material has been available from both hemispheres. The spores measure 18–24 × 4–5 μ, are obtuse above, slightly curved and pointed toward the lower end, and about half the collections examined from both North America and Europe have a few or practically all of the spores with a small inconspicuous cilium at the lower end and much less frequently at the upper end also. No cilia could be found on the spores of Peck's type of

H. gracile. Most of the published illustrations of the species, nearly all of which are cited above are poor and even inaccurate, many especially tending to exaggerate the prominence of the cilium. The reader interested in additional information will find the story fairly complete under the citations of synonymy.

HELOTIUM LIMONIUM Cooke & Peck, *in* Peck, Ann. Rep. N. Y. State Mus. **26** (1872): 83. (April) 1874; Cooke, Bull. Buffalo Soc. **2**: 299. 1875; Sacc. Syll. Fung. **8**: 250. 1889.
Calycina limonium (Cooke & Peck) Kuntze, Rev. Gen. Pl. 3^2: 448. 1889.

FIG. 7

Apothecia minute, more or less gregarious, solitary or in crowded groups of 3–4, slender stipitate, in the dried condition 0.3–0.6 mm. high and 0.4–0.7 mm. across the disc; **stipe** papillate, or more often definite and distinct, slender, cylindric or slightly enlarged above, smooth, pale buff; **disc** rather thin, spreading; **receptacle** in dried specimens smooth, not wrinkled, pale buff or creamy-yellow, concolorous with stipe; **hymenium** waxy, approximately plane in dried material and varying from deep bright yellow to orange; **margin** regular, smooth, sometimes slightly raised above the hymenium in dried specimens to form a slight sterile brim; **paraphyses** simple, slightly clavately enlarged at the apex, about 2–3 μ diam.; **asci** clavate-cylindric, 45–60 $\times$ 5 μ; **ascospores** biseriate cylindric or rarely slightly oblong, straight or slightly flexuous, obtuse or subobtuse at the ends, 6.5–8 $\times$ 2 μ, 1-celled, the content not granular but sometimes with a group of two or three minute oil drops in one or both ends.

On dead herbaceous stems, mostly of undetermined species; one specimen said by the collector to be on *Mentha* sp. (Iowa).

Previously reported from New York and erroneously from Michigan; material has been examined from Iowa and New York. Sept.–Oct.

MATERIAL EXAMINED: *New York:* Center. Oct. *C. H. Peck (294)*. (NYS; CUP–D *3447, 5964, 5965, 8462*); *Iowa:* Iowa City. Oct. 10, 1936. *G. W. Martin, 5194*. (FH); *Locality unknown:* Ex Herb. Ellis, as *Helotium album* Schum. (No other data supplied). (FH).

At Albany there is a packet containing a large amount of material and bearing the following data: *"294. Helotium limonium* C. & P. Center. Oct." In addition there is a sheet on which are pasted four pieces of stem and bearing no data other than the locality. A drawing by Peck accompanying the sheet shows allantoid spores, but examination of an apothecium from one of the pieces (lower right) shows them to be straight and in perfect agreement with those of all the other numbers cited above. No. *3447* in the Durand Herbarium bears Peck's number *294* and is marked "type." The range of numbers on the Durand packets is evidence of duplication as a result of two or three different visits to the Peck Herbarium. It seems highly probable that Peck made only one collection of the species.

Distinguished from *H. albuminum* by its very slender, brightly colored apothecia with smooth receptacle and stipe, straight spores, and occurrence on dead herbaceous stems. The specimen reported by Miss Kanouse (Papers Michigan Acad. **23** (1937): 152. 1938) as *Helotium limonium* is here referred to *H. albuminum*.

Helotium destructor Peck, nom. nov.

Peziza subcarnea Cooke & Peck, *in* Cooke, Synop. Discom. U. S., Bull. Buffalo Soc. Nat. Sci. 295. Mr 1875; Peck, Ann. Rep. N. Y. State Mus. **27** (1873): 107. (Dec.) 1875. [Not *Peziza subcarnea* Schum. = *Helotium subcarneum* (Schum.) Sacc. Michelia **2**: 260. 1881.]

Phialea subcarnea (Cooke & Peck) Sacc. Syll. Fung. **8**: 265. 1889; Povah, Papers Michigan Acad. **20** (1934): 129. *pl. 23, fig. 2.* 1925.

Hymenoscyphus subcarneus (Cooke & Peck) Kuntze, Rev. Gen. Pl. 3^2: 486. 1889.

FIG. 8

Apothecia minute, scarcely visible to the unaided eye, solitary, sparse or rather numerous, originating from the leafy branches, stipitate, in the dry condition pale yellow or hyaline-yellow, concolorous throughout, waxy-cartilaginous, reaching a height of 1 mm. and a diameter across the disc of 0.5 mm. though usually considerably smaller; when young papillate, then elongating, enlarging at the apex, becoming subglobose with a rather deep pore;

stipe long for the size of the apothecium, rather firm, about 0.3–0.5 mm. long, cylindric, slightly broadened at juncture with disc, not wrinkled in drying, hyaline-yellow in dried material, entirely smooth or more rarely with a thin scattering of white cottony hyphae about the base; **disc** at first subglobose, then shallow-infundibuliform, finally saucer-shaped, with turned up margin, rather thick, about 0.2–0.4 mm. diam.; **receptacle** entirely smooth, of color and consistency comparable to that of the stipe, not wrinkled in drying; **hymenium** waxy to waxy-cartilaginous, in dried material similar in color and consistency to other parts or sometimes of a more opaque cream-yellow; **margin** circular, smooth, elevated, obtuse; **paraphyses** simple or once or twice forked, scarcely or not at all enlarged at apex, 3–3.5 μ diam.; **asci** 40–50 $\times$ 5–6 μ; **ascospores** piriform, 4.5–6 $\times$ 2–2.5 μ, the content not granular, biseriate.

Growing on and apparently killing various species of Jungermaniaceous liverworts and mosses; *Jungermania* sp. (Peck, *type*), *Dicranum flagellare* Hedw. (Povah, l. c. and spec. coll. H. S. Jackson, *1548*.

Previously recorded from New York, Michigan, and Alberta; material has been examined from these regions and also from New Hampshire and Ontario. Peck's type was dated July; otherwise all known collections were made in September. Probably not uncommon in eastern U. S. and Canada.

MATERIAL EXAMINED: *New York:* Indian Lake. July. *Peck. 319. Type.* (CUP–D *3751,* NY, NYS); Indian Lake. July. *Peck.* (Dupl.?). (CUP–D *5855*); Adirondack Mts. Aug. *Peck.* (CUP–D *5853,* NY); Catskill Mts. *Peck.* (NYS, CUP–D *5854*); Cattin Lake. *Peck.* (CUP–D *9109*); Essex Co. Aug., 1888. *G. A. Rex.* (CUP–D *8368,* NY); Adirondack Mts. *Rex.* E. & E. N. Am. Fungi *2143.* (CUP–D *2981,* FH); *New Hampshire:* All collected by Farlow at Shelburne: Sept., 1891. (CUP–D *8403*); Sept., 1891. (Dupl.?). CUP–D *10288*); Sept., '93. (FH); Sept., 1897 (CUP–D *10287,* FH); Sept., 1897. (FH); *Michigan: E. T. Harper, 3297.* (CUP–D *3265*); Sept. 1, 1930. *J. L. Lowe.* Ex Herb. Univ. Mich. (FH); *Ontario:* Bear Island, L. Temagami, Sept. 15, 1929. *H. S. Jackson* (*1548*) & *G. Thompson* (NY); Round Lake, Temagami Forest Reserve. Sept. 2, 1932. *Jackson.* Univ. Toronto, *5854* (FH); Diamond Lake, T.

F. R. Sept. 2, 1935. *Jackson.* Toronto, *7999.* (FH); Long Pt., L. Temagami, T. F. R. Sept. 10, 1936. *R. F. Cain.* Toronto, *10094.* (OTB); *Alberta:* Lac Clair. Sept. 1888. (FH).

The pathogenic habit of the species was noted by Peck in his original description and has also been observed by Dr. Jackson who informs the writer that the apothecia are best located by first searching out the brown areas in green patches of mosses where the plants have evidently been killed by the fungus. There seem to be no morphological differences between the forms on liverworts and those on mosses. A large number of inoperculates have been described on liverworts and especially on mosses, but in so far as can be determined *H. destructor* is distinct.

HELOTIUM FASTIDIOSUM Peck, Ann. Rep. N. Y. State Mus. **27** (1873): 107. (Dec.) 1875; Sacc. Syll. Fung. **8**: 221. 1889. *Calycina fastidiosa* Kuntze, Rev. Gen. Pl. **3**[2]: 448. 1898.

FIGS. 2, 9

Apothecia small, slender, delicate, stipitate, 1–1.5 to rarely 3 mm. high, 0.8–1.5 mm. diam. across the disc; **stipe** very slender, subcylindric, smooth, dilute white to practically hyaline, sometimes more or less discolored toward the base, thickened slightly just below the disc, expanding abruptly into disc, not changing in drying except for a deepening of the color to a hyaline-yellow or pale whitish-yellow, sometimes becoming light brown especially on the lower portion; **disc** flat expanded at maturity, medium thin; **receptacle** smooth, dilute white to whitish-yellow, rarely varying to pale ochraceous with age, not changing on drying except for a slight deepening of color; **hymenium** slightly convex with maximum water content, opaque, white or more often pale yellow, on drying becoming plane to saucer-shaped, waxy, the color deepening somewhat to pale or bright yellow, approximating apricot yellow (R), or more rarely as dark as deep chrome; **paraphyses** simple, slightly or not at all enlarged at apex, 2.5–3.5 μ diam.; **asci** not originating from croziers, clavate, 80–100 $\times$ 9–12 μ; **ascospores** clavate, slightly curved, the curvature mostly near the upper end, 26–36 $\times$ 3.5–4.5 μ, biseriate, each containing a single row of from 6–10 oil globules.

On petioles and midveins of decaying leaves of *Alnus incana, Alnus* sp., and decaying catkin of undet. species, probably *Alnus.*

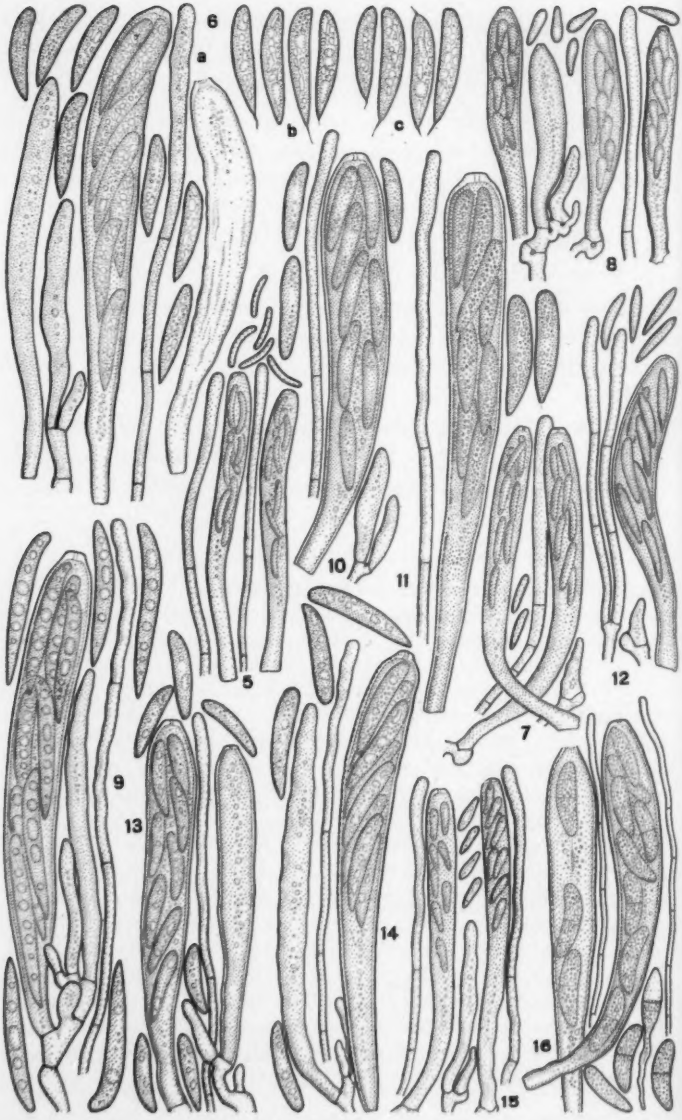

FIG. 5, *Helotium albuminum*, × 915 (CUP–D *5612*); 6, *Helotium scutula*: a, *type* of *Helotium gracile* Cooke & Peck, × 850 (NYS); b, Herb. Barbey-

Previously known only from Peck's New York material; material has been examined from New York, Oregon, and Quebec. August and September. Common in New York and probably also elsewhere.

MATERIAL EXAMINED: *New York:* Forestburg. Sept. *Peck. Type.* (NYS, CUP–D *5948*); Adirondack Mts. *Peck.* (NYS, CUP–D *5949*); Labrador Lake, near Tully. Aug. 26, 1935. *Whetzel & White.* (CUP *24817*, FH); Lloyd Preserve, McLean. Sept. 6, 1935. *Whetzel, White (2040), & D. P. Rogers.* (FH). *Oregon:* Tilly Jane Creek, Mt. Hood. Aug. 26, 1933. *J. Kienholz, 137.* Comm. Miss Cash ex U. S. D. A. Path. & Mycol. Coll. (FH). *Quebec:* Duchesnay. Aug. 24, 1938. *Whetzel.* (CUP *27414*, FH); Duchesnay. Aug. 26, 1938. *Whetzel.* White no. *3368.* (FH); Duchesnay. Aug. 26, 1938. *Whetzel.* White no. *3372.* (FH).

Helotium fastidiosum appears not to have been recorded again since the original description. It seems to be easily distinct from all other species known to the writer. In its long, narrow, characteristically shaped spores it is distinct from nearly all other members of the genus, and from all save one, **Helotium Dearnessii** (Ellis & Ev.) comb. nov. (Syn.: *Phialea Dearnessii* Ellis & Ev.), which have thus far been found in Eastern North America. The latter, known only from the type taken at London, Ontario, and a more recent collection by J. W. Groves from Duchesnay, has greatly elongated spores which are, however, characteristic in their acute apex and long attenuate base, and the species occurs on dead herbaceous stems. Other closely allied species are *Helotium scutula* (Pers. ex Fries) Karst. which occurs on dead herbaceous

Boissier *1302* as *Helotium scutula*, × 850 (FH); c, Jaczewski, Komarov, & Tranzschel, Fungi Rossiae Exsiccati *243* as *Belonioscypha ciliatospora*, × 850 (F); 7, *Helotium limonium*, × 915 (CUP–D *5964*); 8, *Helotium destructor*, from specimen taken in Catskill Mts. by Peck, × 850 (NYS); 9, *Helotium fastidiosum*, × 850 (CUP *27414*); 10, *Helotium turbinatum: type* of *Helotium bryogenum* Peck, × 915 (CUP–D *5924*); 11, *Helotium naviculasporium*, from Sydow, Mycotheca Marchica *3772*, as *Helotium sordatum* Karst., × 915 (FH); 12, *Helotium planodiscum, type*, × 850 (NYS); 13, *Helotium albopunctum, type*, × 850 (NY); 14, *Helotium fraternum, type*, × 850 (FH); 15, *Helotium episphaericum, type*, × 915 (CUP–D *5947*); 16, *Helotium mycetophilum, type*, × 915 (CUP–D *5973*).

stems, and *H. naviculasporum* Ellis on decaying leaves; both have spores somewhat shorter and broader than are those of *H. fastidiosum*.

HELOTIUM TURBINATUM (Fuckel) Boudier, Hist. Classif. Discom. Europe 113. 1907.

Leucoloma turbinata Fuckel, Symb. Myc. 318. 1869.

Helotium bryogenum Peck, Ann. Rep. N. Y. State Mus. **30** (1876): 61. (Nov.) 1878; Sacc. Syll. Fung. **8**: 213. 1889.

Humaria turbinata (Fuckel) Sacc. Syll. Fung. **8**: 127. 1889.

Plicaria turbinata (Fuckel) Rehm, *in* Rabh. Krypt.-Fl. 1^3: 1009. 1895.

Belonium bryogenum (Peck) Rehm, Ascom. *1279;* Hedwigia **38**: 244. 1898.

Calycina bryogena (Peck) Kuntze, Rev. Gen. Pl. 3^2: 448. 1898.

Helotium turbinatum (Fuckel) Boud. Hist. Classif. 113. 1907.

Calycella turbinata (Fuckel) Höhnel, Sitz.-ber. Akad. Wien. 127^1: 594 (46). 1918.

FIG. 10

Apothecia solitary, sparse, short-stipitate, fleshy, medium brown when dry, reaching a height of 0.3 mm. and a diameter of about 0.8 mm.; **stipe** short but usually distinct, stout, cylindric, smooth, when dry medium brown and not at all wrinkled; **disc** thick, fleshy, 0.3–0.8 mm. diam. in dried specimens, the larger reaching 1 mm. when moistened; **receptacle** concolorous with stipe, smooth, not wrinkling in drying; **hymenium** in dried specimens medium to dark brown, waxy to waxy-cartilaginous, plane to slightly concave; **margin** obtuse, smooth, even, not elevated above hymenium; **paraphyses** simple or once branched near the base, slightly clavately enlarged at the apex; **asci** clavate, 70–90 × 8–11 μ, sometimes noticeably broad at the base, not originating from croziers; **ascospores** elongate, straight or very slightly curved, 1- or rarely 2-celled, 16–23 × 3–4 μ, slightly oblong, the ends obtuse or more or less pointed, biseriate.

On various mosses; previously recorded in the literature on *Polytrichum juniperinum* (Europe), *Hypnum* sp. (Europe), and *Hypnum delicatulum* (N. Am.).

Known only from New York and Germany. The single New York collection was made in September.

MATERIAL EXAMINED: **North America**: *New York:* Maryland, Otsego Co. *Peck. Type* of *Helotium bryogenum.* (CUP–D *5924,* FH). **Europe**: *Germany:* Near Heidelberg. Fuckel, Fungi Rhen. *1177.* Incorrectly labeled *Peziza muscorum* Fr. (FH); "Dahren bei Bautzen (Sachsen)." *Feurich.* Rehm, Ascom. *1279.* (FH); "Bei Dahren nächst Göda." Dec. 11, 1910. Krieg. Fungi Saxon. *2168.* (FH). On *Polystichum commune.* "Hohe Kammer bei Matten (Rhön)." Nov. 15, 1916. (FH–H); On *Cryptodon Hartmannii.* "Steinernes Moor bei Oberriedenberg (Rhön)." Nov., 1916. *Ade.* (FH–H); On *Hynum cupressiforme.* "Dahren in Sachsen." June 30, 1918. Feurich. (FH–H).

This species seems not to have been recorded again for America since Peck's original description. Several good descriptions have appeared under the various names in European literature. The brief summary by von Höhnel (l. c.), while based largely on assumption, nevertheless seems to be correct.

Several collections in the Durand Herbarium as *Helotium bryogenum,* represent, exclusive of a fragment of Peck's type, the lichen, *Microphiale diluta.* There scarcely are any characters, either superficial or microscopic, to account for such mistaken identification.

HELOTIUM NAVICULASPORUM Ellis, Bull. Torrey Club **5**: 46. 1874; Cooke, Bull. Buffalo Soc. Nat. Hist. **2**: 299. 1875; Sacc. Syll. Fung. **8**: 211. 1889; Ellis, Cat. Pl. New Jersey 551. 1890; Rehm, *in* Rabh. Krypt.-Fl. 1^3: 780. 1893.

Helotium saprophyllum Cooke & Peck, *in* Peck, Ann. Rep. N. Y. State Mus. **29** (1875): 55. 1878; Cooke, Bull. Buffalo Soc. 3^1: 23. 1875. As *nom. nud.;* Sacc. Syll. Fung. **8**: 227. 1889.

Calycina naviculaspora (Ellis) Kuntze, Rev. Gen. Pl. 3^2: 448. 1898.

Calycina saprophylla (Cooke & Peck) Kuntze, Rev. Gen. Pl. 3^2: 449. 1898.

Helotium sparsum Boud. Hist. Classif. Discom. Europe 111. 1907; Icones Myc. *pl. 495.* 1905–10; Sacc. Syll. Fung. 22^1: 649. 1913; Kanouse, Papers Michigan Acad. **22** (1936): 119. 1937.

FIGS. 3, 11

Apothecia scattered, sparse, minute, delicate, slender-stipitate, hyaline-white when fresh, becoming opaque and more or less yellowish or ochraceous on drying, reaching a height of 0.75–1.5 mm. and a diameter across the disc of 0.4–1.3 mm.; **stipe** slender, delicate, smooth, dilute white when fresh, sometimes yellowish at the substratum, drying semi-opaque and white to creamy yellow; **disc** at first elongate, thick, wine-glass shaped, plane, then expanding and at maturity spreading, of medium thickness, immarginate; **receptacle** smooth, hyaline to dilute white when fresh, drying opaque and yellowish; **hymenium** plane from the very young stages to complete maturity, finally somewhat convex with maximum moisture content, tender, white, more opaque than stipe and receptacle, drying waxy and pale yellow to ochraceous, remaining plane or nearly so; **paraphyses** simple, slightly or not at all enlarged at apex, 2–3 μ diam.; **asci** clavate, 80–90 (–110) $\times$ 8–11 μ; **ascospores** elongate, slightly curved, obtuse above, pointed at lower end, 16–21 $\times$ 4–5 μ, typically more or less filled with irregular refractive granules, biseriate.

On fallen decaying leaves, the apothecia usually originating from the midrib or veins, more rarely on petioles or parenchyma of blade: *Acer* sp., *Alnus incana, Carya* sp., *Fagus grandifolia, Tilia americana* in North America, and on *Alnus* sp., *Quercus* sp., and *Spiraea* sp. in Europe.

Previously recorded for New York, New Jersey, Michigan, and France; material has been examined from all of these regions and in addition from Germany. A late summer species common in New York from July through September.

MATERIAL EXAMINED: **North America**: *New York:* Lake Pleasant. *Peck. Type* of *Helotium saprophyllum.* (NYS, CUP–D *5987*); Indian Lake. August. *Peck.* (CUP–D *5989,* NYS); Adirondack Mts. *Peck.* (CUP–D *5990,* NYS); Lowville. Sept. *Peck.* (NYS); Sandlake. July. *Peck.* (CUP–D *5832*); Ridgeway, Orleans Co. 1904. *C. E. Fairman, 33.* (CUP–D *462,* NYS); Labrador Lake, near Tully. Aug. 26, 1935. *Whetzel* & *White.* (CUP *24821,* FH); Lloyd Preserve, McLean. Oct. 20, 1935. *Whetzel* & *White.* (FH); Old Forge, Adirondack Mts. Sept. 3, 1936. *Whetzel* & *White.* (CUP *25515,* FH); Little Ravine, below Newfield, near Ithaca. Sept. 14, 1938. *Whetzel,*

White, & *Sproston.* (CUP *27890,* FH, U. S. D. A.); same locality and date. (CUP *27891,* FH). *New Jersey:* All Ellis collections as *Helotium naviculasporum:* Ellis, Fungi Nova-Caesareenses *53* (NY); Ellis, N. Am. Fungi *62* (CUP–D *2972,* NY); Newfield. 2 June, 1876. (CUP–D *8465*); Newfield. July, 1876. (FH). *Michigan:* Marquette. Sept. 10, 1934. *E. B. Mains, 34–144.* Comm. Miss Kanouse as *Helotium sparsum.* (FH). **Europe**: *France:* Env. le Rouen. 8–1889. Leg. Letendre, *2087.* Incorrectly determined as *Helotium scutula* var. *albida.* (FH–P). *Germany:* Berlin. 10, 1892. Sydow, Myc. March. *3772.* Incorrectly determined as *Helotium sordidatum* Karst. (FH).

All the specimens cited agree remarkably well in their characters with the exception of the Michigan collection and CUP *27890* from New York, which vary slightly in spore shape from the typical form.

Helotium planodiscum (Peck & Cooke) comb. nov.

Peziza (*Mollisia*) *planodisca* Peck & Cooke, *in* Peck, Ann. Rep. N. Y. State Mus. **31** (1877): 46. (March) 1879.

Pezizella planodisca Sacc. Syll. Fung. **8**: 281. 1889.

Hymenoscypha planodisca Lindau, *in* Engler & Prantl, Nat. Pfl. **1**[1]: 204. 1897.

FIG. 12

Apothecia scattered or subgregarious, pale yellow, sessile, attached by a narrow or less frequently rather broad basal portion but always free toward the margin, reaching a diameter of 0.4 mm. though typically smaller, rather thick; **receptacle** in dried material cream colored to pale yellow, smooth; **hymenium** entirely plane from the earliest stages and always remaining so, pale yellow and waxy in the dried condition; **margin** smooth, subobtuse, regular, not at all elevated; **paraphyses** simple or once or twice branched usually near the base, colorless, clavately enlarged, obtuse, 2.5–3.5 μ diam.; **asci** originating from croziers, clavate, slightly narrowed to a thick pedicel, 40–55 $\times$ 5–7 μ; **ascospores** elongate, straight or slightly curved, narrow oblong fusiform, lacking oil globules, 8–13 $\times$ 2–2.5 μ, obliquely uniseriate with ends strongly overlapping, or biseriate.

On dead leaves and culms of *Andropogon scoparius.* Known only from the type collection.

MATERIAL EXAMINED: *New York:* Buffalo. *G. W. Clinton. Type.* (NYS).

This species appears to be very closely allied with *Helotium flexuosum* Massee (Syn.: *H. citrinulum* Karst. var. *Seaveri* Rehm), which the writer has collected and observed frequently in the vicinity of Ithaca, N. Y., growing on the moist basal parts of leaves and culms of sedges and grasses in May and June. It may later prove synonymous, but since the type, which is very ample and in good condition, differs in certain characters from all the collections that have been referred to *H. flexuosum,* it is desirable that they be kept separate for the present. The latter has apothecia which are rather thin and spreading, frequently reaching a diameter of 1.8 mm., are more or less brightly colored, and field observations over a period of years indicate that they are never to be found after late June. Peck records the collection date for his type as "Nov." but there is good reason to believe that this represents something other than the date of collection—perhaps the date of receiving the material from Clinton. Other instances of such confusion have been encountered.

HELOTIUM ALBOPUNCTUM Peck, Ann. Rep. N. Y. State Mus. **31** (1877): 47. (March) 1879. [Not *Helotium albopunctum* (Desm.) Bucknall, Bristol Nat. Soc. Proc. **3**: 137. 1882.]

Pezizella albopuncta Sacc. Syll. Fung. **8**: 276. 1889.

Hymenoscyphus albopunctus Kuntze, Rev. Gen. Pl. **3**^{2}: 485. 1898.

FIG. 13

Apothecia scattered, solitary, punctiform, when dry visible to the unaided eye only as dots, waxy-cartilaginous, the color to the naked eye similar to that of the dried beech leaves on which they occur, under magnification pale yellow to pale orange, *Peziculа*-shaped, narrowed to a central point of attachment or sometimes to a very short but definite stipe; **disc** rather thick; **hymenium** plane to slightly concave; **margin** elevated to form a slight sterile region about the hymenium; **paraphyses** simple, slightly clavate-enlarged above, 2.5–3.5 μ diam.; **asci** 60–70 $\times$ 8–10 μ, *not* originating from croziers; **ascospores** elongate, straight or slightly curved, rounded above, obtuse-pointed at lower end, 14–16 $\times$ 3.5–4 μ, biseriate, 1-celled, containing a few granules in the cytoplasm.

On *Fagus grandifolia,* fallen leaves of the previous season, little or not at all decayed. Known only from the type. August.

MATERIAL EXAMINED: *New York:* Adirondack Mts. *Peck. Type.* (CUP–D, NY, NYS).

The type packet at Albany contains seven leaves, each with a fairly large number of apothecia. While the ampleness of this collection might lead one to suspect that the species is not of rare occurrence, nevertheless it has not again come to light in the considerable collecting of the writer in New York. Cummins (Papers Michigan Acad. **11** (1929) : 111. 1930) reports the species on the "leaves of Cornus?" from Montana. His material has not been seen but there is no reason from his description to doubt his determination.

HELOTIUM FRATERNUM Peck, Ann. Rep. N. Y. State Mus. **32** (1878) : 47. (May) 1880: Bull. N. Y. State Mus. 1^2: 21. *pl. 1, fig. 12–15.* 1888; Sacc. Syll. Fung. **8**: 218. 1889; Kauffman, Rep. Michigan Acad. **12**: 101. 1910; Coons, Rep. Michigan Acad. **14**: 260. 1912; Millspaugh, West Virginia Geol. Survey **5** (A) : 111. 1913.

Calycina fraterna Kuntze, Rev. Gen. Pl. 3^2: 448. 1898.

FIGS. 4, 14

Apothecia scattered, solitary, stipitate, 1–2.5, rarely 3.5 mm. high, up to 2.2 mm. diam.; at first appearing as erumpent papillae, elongating, becoming cylindric, columnar, a minute pore appearing at the apex followed by expansion of the disc which is subglobose, then shallow cupulate, finally fully expanded, rather fleshy when fresh, of medium thickness; **stipe** and **receptacle** smooth, more or less concolorous, pale yellow to whitish when fresh, sometimes varying to reddish brown toward the substratum, on drying retaining the original shape, rarely becoming very slightly wrinkled, typically becoming orange-buff with a silky or resinous lustre, more rarely dilute-yellow or grayish; **hymenium** at maturity and with maximum moisture content convex, immarginate, concolorous with stipe and receptacle when fresh, wax-yellow to ochraceous orange (R), on losing moisture becoming slightly concave with rather thin elevated margin, the color changing to a deep reddish brown; **paraphyses** simple, scarcely or not at all enlarged at the apex, 2–3 μ diam., colorless in fresh material, the content usually brown-

ish in old specimens; **asci** clavate-cylindric, 70–100 × 10–12 μ; **ascospores** biseriate or subbiseriate, narrow oblong-fusoid, usually very slightly curved, typically with an oil drop in each end but these sometimes confluent or broken into several smaller globules.

On decaying petioles of *Acer;* noted on *A. saccharinum, A. saccharum, A. spicatum,* and *Acer* sp.

Previously reported from New York, West Virginia, and Michigan. Material has been examined from the states listed below.

MATERIAL EXAMINED: *New York:* Adirondack Mts. July. *Peck. Type.* (CUP–D, FH, NY, NYS); North Elba. July. *Peck.* (NYS); Tichner's Glen, Canandaigua. Aug., 1894. *Durand.* (CUP–D *600*); Mt. Whitney, L. Placid. Sept. 3, 1894. *G. F. Atkinson.* (CUP–D *9531*); Fall Creek, Ithaca. Aug. 8, 1895. *Durand.* (CUP–D *831*); Tichner's Glen, Canandaigua. Sept. 7, 1900. (CUP–D *955*); Taughannock, Cayuga Lake Basin. Aug. 6, 1904. *Kauffman.* (CUP–D *2640*); North of Hudson Falls, Wash. Co. Aug. 12, 1918. *Burnham.* (CUP *26646,* FH, NY); Lloyd Preserve, McLean, Aug. 6, 1935. *Whetzel* & *White.* (CUP *24800,* FH); Labrador Lake, near Tully. Aug. 21, 1935. *Whetzel* & *White.* (CUP *24820,* FH); Labrador Lake. Aug. 26, 1935. (FH); Lloyd Preserve, McLean. Sept. 6, 1935. *Whetzel* & *White.* (FH); Labrador Lake. Aug. 12, 1936. *Whetzel* & *White.* (CUP *25455,* FH); another collection. (FH); Lloyd Preserve, McLean. Aug. 18, 1936. *Whetzel* & *White.* (CUP *25486,* FH); another collection. (CUP *25487,* FH); Cascadilla Gorge, Ithaca. Aug. 29, 1936. *White.* (FH); Adirondack Mts. Sept. 3, 1936. *Whetzel, White,* & *Viegas.* (FH); Old Forge, Adirondack Mts. Sept. 3, 1936. *Whetzel* & *White.* (FH); Little Ravine below Newfield, near Ithaca. Sept. 14, 1938. *Whetzel* & *White.* (FH). *Maine:* Millinocket. Sept. 22, 1940. *Linder* & *White.* (FH). *New Hampshire:* Chocorua. 1907. *Farlow.* (FH, NYS). *Ohio:* Oxford. Aug. 11, 1908. *Bruce Fink,* Fink, Ascom. Ohio *51.* (CUP–D *10715*). *Indiana:* Turkey Run, Montgomery Co. Aug. 23, 1917. Fink, Ascom. Indiana *138.* (CUP–D *10714*). *West Virginia:* Albright. Aug. 4, 1908. *J. L. Sheldon.* (CUP–D *6504*).

Field observations on this species indicate that, as is also true of many other species of Discomycetes, the color and consistency of the fruit body depend largely upon growing conditions. If apothecial production is retarded or prevented for any considerable period during the time of normal fruiting, and if this period is then followed by a two or three day period of rain, the apothecia develop very rapidly; they are then likely to be of a pale hyaline-yellow color and to be practically concolorous throughout, and in drying they shrivel somewhat and retain the dilute-yellow cartilaginous appearance. If on the other hand the infested petioles are subjected to a normal, more or less continuous supply of moisture and a certain amount of sunlight, then the apothecia develop more slowly and are marked by a greater depth of color, are more opaque and waxy, and in drying retain both the color and fullness of form of the fresh material. Developed under such conditions the apothecia of this species exhibit in the field, as well as in the herbarium, a most perfect and symmetrical form.

Thus far no other species of *Helotium* has come to the attention of the writer as occurring on the petioles of *Acer,* although certain species known to grow on a wide range of frondose tree dejecta are to be expected here also. A species of *Rutstroemia, R. luteovirescens* (Rob.) White (Lloydia **4**: 211. 1941) occurs on maple petioles within the range of *H. fraternum* but is comparatively uncommon. The apothecia of the two species are of similar size, form, and color, but in the *Rutstroemia* they are fairly well marked superficially by the presence of an olive-green cast and by their origin from a stroma, and microscopically by larger asci and larger, ellipsoid spores.

Peck's type contains abundant material and it is in excellent condition.

HELOTIUM EPISPHAERICUM Peck, Ann. Rep. N. Y. State Mus. **40** (1886): 66. (Jan.) 1888; Sacc. Syll. Fung. **10**: 8. 1892.

Calycina episphaerica Kuntze, Rev. Gen. Pl. **3**[2]: 448. 1898.

Helotium parasiticum Ellis & Ev. Jour. Myc. **9**: 165. 1903; Sacc. Syll. Fung. **18**: 54. 1906.

Dermatea mycophaga Massee, Kew Bull. Misc. Inf. 218. 1908; Sacc. Syll. Fung. **22**[1]: 712. 1913.

FIG. 15

Apothecia minute, sessile or subsessile, 0.2–0.5 mm. in diam., gregarious, solitary or in crowded groups of two to six, in the dried condition waxy-cartilaginous, concolorous throughout, pale yellow to bright orange, usually close to orange-rufous (R); **stipe** usually consisting only of a V-shaped papilla-like attachment, more rarely tending to elongate, smooth; **receptacle** entirely smooth; **margin** slightly elevated, smooth, not at all furfuraceous or puberulent; **hymenium** saucer-shaped in the dried condition; **flesh** white when broken; **ectal excipulum** consisting of thin-walled isodiametric cells; **paraphyses** simple, very slightly enlarged at the apex, about 2 μ diam.; **asci** clavate-cylindric, 48–65 $\times$ 5 μ; **ascospores** narrow-piriform, 1-celled, 4.5–7 $\times$ 1.8–2.5 μ, uniseriate or subbiseriate, usually with a very small oil globule in each end.

On stromatic pyrenomycetous fungi. The substrata as recorded by the collectors is listed below for each collection cited.

Known from New York, Ontario, Germany, and Straits Settlements. Sept. in N. Y. and Ont.; Aug. in Germany.

MATERIAL EXAMINED: **North America**: *New York:* On *Hypoxylon Morsei.* Elizabethtown. Sept. *Peck. Type* of *Helotium episphaericum.* (CUP–D *5947,* NYS). *Ontario:* On *Valsa?* Harraby, Lake Rosseau. Sept., 1902. *E. T. & S. A. Harper. Type* of *Helotium parasiticum.* (FH). On *Diatrypella.* London. Oct., '03. *J. Dearness.* (FH–E *2998*; 189–13). **Europe**: *Germany:* Ybbsitz. August. Leg. Strasser. (FH–H); **Asia**: *Straits Settlements:* On *Xylaria.* Selangor. *Ridley, 158. Type* of *Dermatea mycophaga* Massee. (NY). Only Massey's notes and colored drawings are there; specimen missing!

The species is very closely allied to two others, *H. hymeniophilum* (Karst.) Karst. on the pore surface on various species of *Polyporaceae* in Finland, and *H. griseolum* von Höhnel on the pore surface of *Polyporus concrescens* Mont. from Java. The former (Karst. Fungi Fenniae *730* examined) differs in being a rather dull yellowish to more or less cineraceous in color and in having the excipular and marginal cells extended into definite cylindric, obtuse hairs which are rough as in *Dasyscypha,* and in its somewhat shorter asci. The latter, *H. hymeniophilum* (type in von Höhnel Herbarium examined), has apothecia more definitely stipitate, cineraceous-buff in color, with excipular hairs as in *H. hymenio-*

philum but smooth. The three species should be maintained as distinct at least for the present. Another species, *Pezizella anonyma* Rehm (Rehm, Ascom. *115b, type,* examined) on the stroma of *Valsaria crenata* in Ecuador is of very similar aspect to *H. episphaericum* but is smaller and has subglobose spores.

HELOTIUM MYCETOPHILUM Peck, Ann. Rep. N. Y. State Mus. **43** (1889): 33. (Oct.) 1890; Sacc. Syll. Fung. **10**: 8. 1892.
Calycina mycetophila Kuntze, Rev. Gen. Pl. 3^2: 448. 1889.

FIG. 16

Apothecia scattered or gregarious, appearing singly or more rarely two crowded together, when dry minute, substipitate, 0.1–0.3 mm. diam., more or less turbinate, waxy, dark red and concolorous throughout; **stipe** consisting only of the tapering basal portion of the receptacle or sometimes distinct and cylindric though very short; **disc** rather thick, immarginate; **receptacle** smooth, tapering downward; **hymenium** waxy-cartilaginous, plane or slightly concave when dry; **paraphyses** simple, slightly flexuous, cylindric, scarcely more than 1 mm. diam.; **asci** clavate, 100–120 $\times$ 13–15 μ; **ascospores** uniseriate below, biseriate above, narrow ellipsoid or oblong-ellipsoid, slightly curved or at least flattened on one side, 1–2-celled, 17–21 $\times$ 5.5–7 μ, filled with minute oil globules at least in dried specimens.

On pileus of old sporophore of *Fomes fomentarius.*

Known only from the type collection from New York. August.

MATERIAL EXAMINED: *New York:* Rainbow Lake. August. *Peck. Type.* (CUP–D *5973,* NYS).

The collection left at Albany by Peck consists of rather ample material in a packet, plus four pieces of the substrate pasted openly on an herbarium sheet. The apothecia are dull red in color and in this respect as well as in form they resemble a small, slender *Pezicula.*

EXCLUDED SPECIES

HELOTIUM MACROSPORUM Peck, Ann. Rep. N. Y. State Mus. **26** (1872): 82. (June) 1874. = *Rutstroemia macrospora* (Peck) Kanouse *apud* Wehmeyer, Canad. Jour. Res. **18**: 547. 1940. Species treated fully by White, Lloydia **4**: 184. 1941.

HELOTIUM RUGIPES Peck, Ann. Rep. N. Y. State Mus. **26** (1872) : 82. (June) 1874. = *Chlorociboria versiformis* (Pers. ex Fr.) Seaver, Mycologia **28**: 393. 1936.

HELOTIUM THUJINUM Peck, Ann. Rep. N. Y. State Mus. **26** (1872) : 82. (June) 1874. = *Pithya Cupressi* (Batsch ex Fries) Rehm. See Seaver, N. Am. Cup-Fungi 78. 1928.

HELOTIUM PILEATUM Peck, Ann. Rep. N. Y. State Mus. **28** (1874) : 67. 1876. = *Ombrophila clavus* (Alb. & Schw. ex Fr.) Cooke. Later Peck (Rep. **32** (1878) : 58. 1880) recorded a second collection which he considered a larger form of the species.

HELOTIUM HYDROGENUM Peck, Ann. Rep. N. Y. State Mus. **29** (1875) : 56. 1878. A species of *Mollisia.*

HELOTIUM CARICINELLUM Peck, Ann. Rep. N. Y. State Mus. **30** (1876) : 61. (Nov.) 1878. Probably referable to the Patellariaceae.

HELOTIUM PALUSTRE Peck, Ann. Rep. N. Y. State Mus. **32** (1879) : 48. (May) 1880. = *Ombrophila clavus* (Alb. & Schw. ex Fr.) Cooke.

HELOTIUM VIBRISSOIDES Peck, Ann. Rep. N. Y. State Mus. **32** (1878) : 48. (May) 1880. Later Peck (Bull. N. Y. State Mus. **1**[2]: 28. 1888) indicated that his species was synonymous with *Vibrissia turbinata* Phill. and that the name *Gorgoniceps turbinata* (Phill.) Sacc. should be adopted. The species belongs in *Apostimidium* Karst. which is in a phylogenetic series unrelated to *Gorgoniceps* Karst., but the species concept in *Apostimidium* is much too confused to attempt to settle the question of the specific name at this time.

HELOTIUM AFFINISSIMUM Peck, Ann. Rep. N. Y. State Mus. **33** (1880) : 32. 1883. = *Lachnum pygmaeum* (Fries) Bres., Ann. Myc. **1**: 121. 1903. A long list of synonymy is involved here. Names based on North American material are *Helotium rhizogenum* Ellis & Ev. (Jour. Myc. **4**: 100. 1888) and *H. subrubescens* Rehm (Ann. Myc. **7**: 524. 1909).

PHIALEA ANOMALA Peck, Rep. N. Y. State Bot. for 1912. N. Y. State Mus. Bull. **167**: 29. 1913. = *Rutstroemia longipes* (Cooke & Peck) White, Lloydia **4**: 203. 1941. The apothecia are on stromatized petioles of *Fraxinus;* not on "dead herbaceous stems or twigs" as indicated by Peck.

OLD EUROPEAN SPECIES REPORTED BY PECK FOR NEW YORK

Helotium herbarum (Pers. ex Fries) Fries: *Peziza cyathoidea* Bull. = *Helotium cyathoideum* (Bull. ex Fries) Karst.; *Peziza citrina* Batsch. = *Helotium citrinum* (Hedw. ex Fries) Fries; *Helotium epiphyllum* (Pers. ex Fries) Fries; *Helotium aciculare* Fries = *Cudoniella aciculare* (Bull. ex Fries) Schröt.; *Helotium salicellum* (Fries) Fries; *Helotium lutescens* (Hedw. ex Fries) Fries. No attempt has been made to systematically examine Peck's collections of these species, but all represent species which are of common occurrence in the state.

The writer wishes to thank Dr. D. H. Linder for aid rendered in various ways, and Prof. H. M. Fitzpatrick of Cornell University, Dr. Homer D. House of the New York State Museum, and Dr. Fred J. Seaver of the New York Botanical Garden for making available material and facilities for study at their respective institutions.

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STUDIES ON SOME CALIFORNIA FUNGI II

LEE BONAR

(WITH 2 FIGURES)

The following descriptions of new species and notes on known species represent some of the accumulations of recent years that are considered worthy of notice.

DERMATEA BRUNNEO-PRUINOSA Zeller, Mycologia **26**: 291. 1934.

Pestalozzia (Pestalotia) gibbosa Harkness, Bull. Calif. Acad. **2**: 439. 1887.

The *Pestalotia* leaf spot on *Gaultheria Shallon* Pursh has been found commonly near the coast in northern California and Oregon for many years. Zeller described the discomycete occurring in the same spots with the *Pestalotia,* and suggested that because of the close association of the two forms there was probably an organic connection between them. Leaves bearing the two forms were collected at Trinidad, California, by H. E. Parks. Cultures were grown in the laboratory, from single ascospores of the *Dermatea* and from single conidia of the *Pestalotia.* The two series were grown on a number of common laboratory media and were found to be indistinguishable in growth characters. Sporulation was sparse or lacking on media used, except on oat-meal agar where it was abundant, forming the conidia typical for *Pestalotia gibbosa* in both series, thus proving that the two forms were stages in the life cycle of one organism. No apothecia were obtained in the laboratory cultures.

An interesting relation between temperature and the development of the fungus was observed. Cultures were grown in five different temperature chambers ranging from 8–30° C. Growth was optimum at 15–17° C., while it was markedly reduced at either lower or higher temperatures. Spore formation occurred only in those cultures that were grown at the optimum temperature. This cor-

relates well with the development of the fungus in nature, since it is found along the coastal region where the temperatures are relatively low for a considerable portion of the year.

Culture work on this fungus was carried out by Dr. Paul Harvey.

Haematomyxa Sequoiae (Plow.) comb. nov.

Cenangium Sequoiae Plow. Grevillea **7**: 23. 1878.
Scleroderris Sequoiae (Plow.) Sacc. Syll. Fung. **8**: 596. 1889.

The original description appeared in "Fungi of California" by Wm. Phillips: "Gregarious, turbinate, black, margin connivent; disc black, pale, cinerious within; asci broadly clavate; sporidia 8, ovate, or ovate-oblong, simple, or triseptate, enucleate, .025–.03 × .007–.015 mm.; paraphyses slender, furcate. On *Sequoia gigantea*, No. 639."

Emended description: apothecia gregarious or solitary, erumpent, often becoming superficial, turbinate, black, gelatinous when fresh, horny when dry, externally smooth, reaching a diameter of two mm. (FIG. 2, *a*); excipulum extending beyond the hymenium and incurved, outer layers black, colorless within; hymenium fuscous; asci broadly clavate, wall thickened above, 240–300 × 60–80 μ, eight spores; spores ellipsoidal, or slightly asymmetric, fuscous, muriform, with seven transverse septa, slightly constricted at heavier median septum, two to three seriate in ascus, 60–80 × 20–30 μ; asci and spores vary greatly as to size and maturity in a single hymenium. Paraphyses abundant, much branched above, and the tips colored to form a dark epithecium (FIG. 1, *e*). In the bark of fallen branches of *Sequoia* in California.

Material examined: on *Sequoia gigantea* (Lindl.) Dec.: Big Trees, Calif. Herb. Calif. Acad. Sciences, Harkness No. *639X*; two from Yosemite National Park; Tuolumne Grove, June 1933, and Mariposa Grove, May 1934, Lee Bonar; Sequoia National Park, July 1934, H. E. Bailey: on *Sequoia sempervirens* (Lamb.) Endl.: Bolling Grove, Humboldt Co., July 1933, Lee Bonar.

Efforts to learn the location of the type material of Plowright have failed, but scant material preserved in the California Academy of Sciences Herbarium is numbered 639X and notes in Harkness' handwriting designate it as a portion of the collection sent to Plowright and published through Phillips. This material of the Harkness collection corresponds in all features with the recent collec-

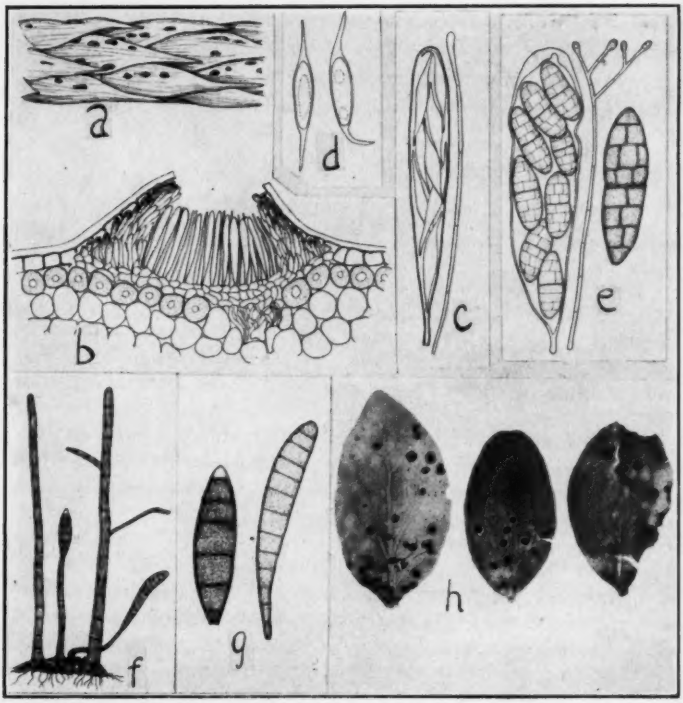

FIG. 1. *a–d, Pezizella aristospora: a,* apothecia in leaves, *b,* structure of apothecium in section, *c,* ascus and paraphysis, *d,* ascospores; *e, Haematomyxa Sequoiae:* ascus, paraphysis and ascospore; *f–g, Chaetotrichum macrosporum: f,* setae and conidia, *g,* two types of conidia; *h, Strumella Simmondsiae:* habit on leaves, × ½.

tions, and examination of immature stages in the latter shows the same characters given in the original description. It is obvious therefore that the description was drawn from immature material.

Pure cultures grown from single ascospores in the laboratory failed to show any conidial stage of reproduction. Cultures grown on sterilized twigs of *Sequoia* in test tubes developed apothecia which formed asci and spores after four to five months.

I am indebted to Dr. F. J. Seaver for assistance in the study of this species.

Pezizella aristospora sp. nov.

Apothecia dispersa, solitaria, intra-epidermalia, per cuticulam crassam irregulariter erumpentia, orbicularia vel elliptica, 0.5–1 mm. diam., in humido cupularia et molliter ceracea, in sicco cornea, margine involuta; excipulum tenue, molle, leve, prosenchymaticum, superficie externa fusca (apicibus hypharum plus minusve parallelarum fuscobrunneis), marginem supra hymenium fusco-carneum paulo extendentem constituens; hypothecium tenue, parenchymaticum, hyalinum; asci cylindraceo-clavati, ad apicem obtusati, 95–110 × 10–12 μ, apices iodo caeruleis nontinctis, octosporii, sporidia uniseriata vel biseriata, continua, levia, hyalina, attenuato-fusoidea, apicibus longe apiculiformibus, recta vel paulum arcuata, 1 vel 2 guttis, 20–25 × 4–5 μ; paraphyses multae, ascos aequiparantes vel superantes, apicibus usque ad 3–5 μ tumifactis, achromaticae, pariete gelatinoso.

Apothecia scattered, single, intra-epidermal, erumpent, the heavy cuticle breaking irregularly, circular to elliptic, 0.5–1 mm. in diameter, soft waxy and cupshaped when moist, horny when dry, margin inrolled when dry (FIG. 1, *a*); excipulum thin, soft, smooth, prosenchymic, the tips of the more or less parallel hyphae dark brown, making the outer surface fuscous, extending somewhat as a sterile margin above the dark flesh-colored hymenium, hypothecium thin, parenchymic, hyaline (FIG. 1, *b*); asci cylindric-clavate, obtuse above, 95–110 × 10–12 μ, tips not blue with iodine, 8-spored, spores uniseriate to biseriate; spores 1-celled, smooth, hyaline, attenuated-fusoid, one or two oil drops, 20–25 × 4–5 μ, tips extended as elongate apiculi, straight or somewhat curved; paraphyses numerous, equaling or exceeding the asci, tips enlarged to 3–5 μ, colorless, with a gelatinous wall (FIG. 1, *c*, *d*).

In dead leaves, small fallen twigs, *Sequoia gigantea* (Lindl.). Dec., Tuolumne Grove, Yosemite National Park, California, July 23, 1933, Lee Bonar, type, Univ. Calif. Herb. *653847*.

Clithris Sequoiae sp. nov.

Hysterothecia atra, in ligno patenti aut per corticem erumpentia, saepe confluentia et in ligno strias longas atras formantia, valde carbonacea, linearia vel oblongo-linearia, ad extremitates acuta, lateraliter applanata, usque ad 5 mm. longa, 0.2–0.5 mm. lata, ad 0.8 mm. alta, rima longa irregulari aperta sine labiis distinctis vel periphysibus; asci angusti, cylindracei vel subclavati, superne rotundati vel subacuti, ad pedicellum longum tenuem, attenuati, 90–120 × 6.5–8 μ, tetra vel octospori; sporidia hyalina, acicularia, sine septis, recta vel in asco paulo torta, plus minusve fasciculata, superne obtusata et ad basin plus minusve attenuata, magnitudinis variae, plerumque 50–55 × 0.75–1.25 μ, in asco sporidia in matrice tenui gelatinosa (quae in sporidiis solitis non manifesta) tunicata; paraphyses non clavatae, varie geniculatae vel compressae, filiformes, simplices, hyalinae, 83–135 × 1–1.5 μ.

Hysterothecia dull black, on exposed wood or erumpent through bark, often confluent and forming long black striae on wood, heavily carbonized, linear or oblong linear, acute at ends, laterally compressed, up to 5 mm. long, 0.2–0.5 mm. wide, up to 0.8 mm. high, opening by a long irregular slit, without distinct labia or periphyses; asci narrow, cylindric to sub-clavate, rounded to sub-acute above, tapering from above middle to a long slender stalk, 90–120 × 6.5–8 μ, 4 or 8 spored; spores hyaline, needle-like, non-septate, straight or somewhat twisted in ascus, more or less in fascicles, rounded above and tapering toward the base, varying in length, chiefly 50–55 × 0.75–1.25 μ, in ascus apparently incased in thin gelatinous matrix, which is not evident on free spores; paraphyses not clavate, variously bent or crushed above, filiform, simple, hyaline, 85–135 × 1–1.5 μ.

On dead branches of *Sequoia sempervirens* (Lamb.) Endl., Trinidad, Humboldt Co., California, Nov. 1931, H. E. Parks *4020*, type, Univ. Calif. Herb. *653855*. Same locality, March 1932, Parks *3392*, Feb. 1939, Parks *4639*.

This species is very near to *Clithris crispa* (Pers.) Rehm, but differs from this in its longer and narrower hysterothecia, the larger asci and the clavate narrow spores.

I am indebted to Dr. L. R. Tehon for assistance in the study and description of this material.

Mycosphaerella Sequoiae sp. nov.

Perithecia multa, hypophylla, raro epiphylla, dispersa, solitaria vel crebra, subepidermalia, globosa, ostiolo brevi papilliformi erumpentia, 90–125 μ diam., pariete carbonaceo, 10–20 μ crasso; asci fasciculati, elongato-cylindracei, superne paulum angustati, breviter stipitati, octospori, 50–60 × 10–12 μ; ascosporidia fusiformi-elliptica, hyalina, bicellularia, 11–14 × 3–4 μ, cellula basilari paulum angustata, cellulis pariter longis; paraphyses nullae.

Perithecia numerous, hypophyllous, rarely epiphyllous, scattered, single or clustered, subepidermal, globose, erumpent by a short papillate ostiole, 90–125 μ diameter, wall carbonaceous, 10–20 μ thick; asci fasciculate, elongate-cylindric, slightly narrowed above, short stipitate, 8-spored 50–60 × 10–12 μ; ascospores fusiform-elliptic, hyaline, 2-celled, 11–14 × 3–4 μ, basal cell somewhat narrowed, cells of equal length; paraphyses none.

On leaves and young twigs of *Sequoia sempervirens* (Lamb.) Endl., Trinidad, Humboldt Co., California, H. E. Parks, spring 1932, type, Univ. Calif. Herb. *653844*, Feb. 1, 1933.

Infection starts at the tips of the leaves and progresses to the base. High percentage of the leaves often killed, giving the mass of foliage a blasted appearance.

Phaeosphaerella Rhamni sp. nov.

Maculae amphigenas irregulares, 1–2 cm. diam., pallide brunneae, margine castaneo, fuscantes in maturitate peritheciorum et reticulantes cum hyphis brunneis sub cuticula; perithecia dispersa vel aggregata, epiphylla, subepidermalia erumpentia, globosa, 100–125 μ diam., ostiolo poroideo, pariete membranaceo; asci octospori, fasciculati, cylindracei, breviter stipitati, 42–45 $\times$ 9–10 μ; sporidia uniseriata vel biseriata, ellipsoidea, bicellularia, non constricta, olivacea, 11–14 $\times$ 4–5 μ, cellula inferna paulo angustata; paraphyses nullae.

Spots amphigenous irregular 1–2 cm. diameter, light brown with a reddish-brown border, becoming darker with the production of perithecia and reticulate with the development of brown hyphae under the cuticle; perithecia scattered to crowded, epiphyllous, subepidermal, erumpent, globose, 100–125 μ diameter, ostiole poroid, wall membranaceous; asci 8-spored, fasciculate, cylindric, short-stipitate, 42–55 $\times$ 9–10 μ; spores uniseriate or biseriate, 2-celled ellipsoidal, non-constricted, olivaceous, 11–14 $\times$ 4–5 μ, lower cell somewhat narrowed; paraphyses none.

Parasitic on living leaves of *Rhamnus californica* Esch., 18 Mile Creek, Smith River, Del Norte County, California, type, Univ. Calif. Herb. *653842,* July 13, 1933, Lee Bonar and H. E. Parks.

Diedickea Piceae sp. nov.

Pycnidia amphigena, dispersa vel crebra, omnino superficialia, in subiculo tenuissimo et ab folii pagina facile separante disposita; subiculum reticulum tenue ex hyphis tenuis hyalinis et raris crassioribus brunneis textum; pycnidia disciformia, radiata, ostiolo nullo, in maturitate stellate dehiscentia, 200–400 μ diam., strato externo fusco vel atro, strato basilari obscuro ex hyphis tenuis hyalinis texto; conidia elliptica, hyalina, continua, 2.5–3.5 $\times$ 1 μ, in massis mucosis adhaerentia; conidiophora nulla.

Pycnidia amphigenous, scattered or crowded, entirely superficial, borne on an extremely thin subiculum which separates readily from the leaf (FIG. 2, *b*); subiculum of a thin meshwork of fine hyaline hyphae with occasional larger brown hyphae; pycnidia disciform, radiate, non-ostiolate, opening at maturity by stellate dehiscence, 200–400 μ diameter, outer layer fuscous to black, basal layer indistinct, of fine hyaline hyphae; conidia elliptic, hyaline, 1-celled, 2.5–3.5 $\times$ 1 μ, clinging together in mucoid masses; conidiophores none.

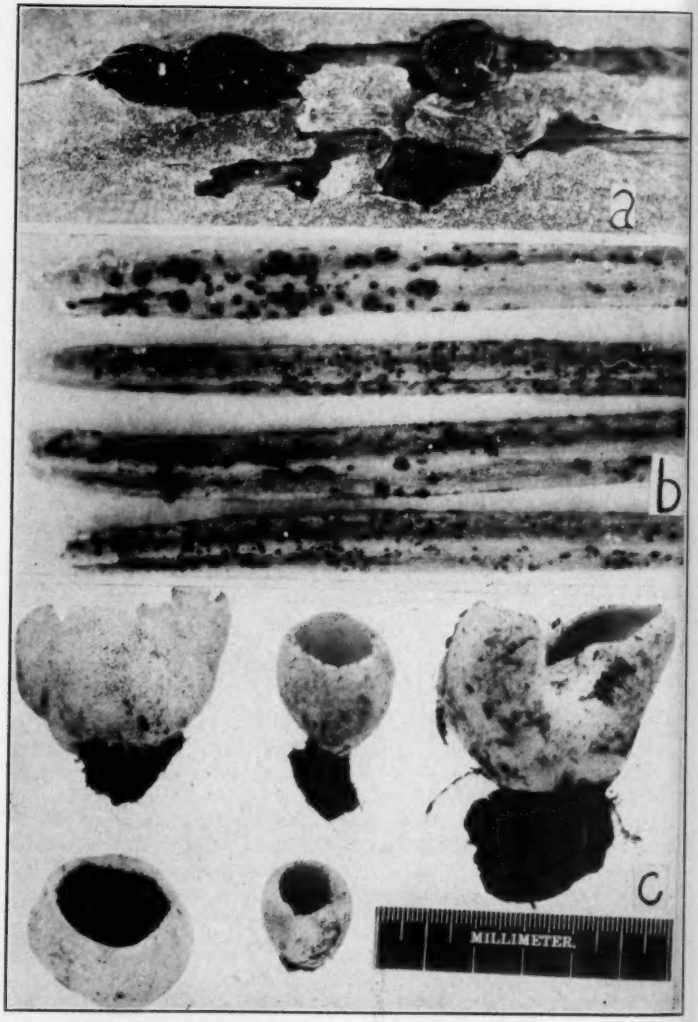

FIG. 2. *a, Haematomyxa Sequoiae,* apothecia in bark, ×7; *b, Diedickea Piceae,* pycnidia on leaves, ×10; *c, Peziza ochracea,* apothecia.

On leaves of *Picea sitchensis* (Bong.) Carr., Trinidad, Humboldt County, California, May 1931, H. E. Parks *3890,* type, Univ. Calif. Herb. *653851;* Nov. 1932, Parks *4059.*

The fungus causes yellowing and discoloration of the leaves and early leaf fall. It appears on the current season's foliage in the autumn, and becomes conspicuous on these leaves the following summer. As the leaves become yellowed, the pycnidia separate from the leaf and fall off.

This species has a more delicate subiculum than that described and figured for the type species of the genus by Sydow (Ann. Myc. **11**: 268–269. 1913.) but the structure of the pycnidia, the manner of dehiscence, the mucoid nature of the spore masses, and the lack of conidiophores place it within the genus.

Dothichiza Garryae sp. nov.

Maculae primo parvae, denique maiores et confluentes, saepe totum folium occupantes, cinereo-brunneae, margine purpureo; pycnidia amphigena, plerumque epiphylla, dispersa solitariaque, subepidermalia, denique plus minusve superficialia cuticulis levatis, 200–325 μ diam., pariete sclerotioideo, 30–40 μ crasso, operculo plano, deplapso in sicco, ex cuticula folii nigrescente constituto, decidente; conidia cupulae pycnidii ubique superficiem internam occupantia, cylindraceo-ellipsoidea, hyalina, continua, 14–20 × 3.5–4.5 μ; conidiophora brevissima vel obsoleta.

In spots, small at first, becoming larger and confluent, often involving the entire leaf, cinereous brown with a purplish border; pycnidia amphigenous, mostly epiphyllous, scattered, single, subepidermal, becoming semisuperficial by lifting of the cuticle, 200–325 μ diameter; pycnidial wall of sclerotial tissue, 30–40 μ thick, lid flat, sunken when dry, consisting of cuticle of the host somewhat blackened, and falling away in dehiscence leaving an open cupulate chamber; conidia borne on entire inner surface of the chamber, cylindric-ellipsoid, hyaline, continuous, 14–20 × 3.5–4.5 μ; conidiophores extremely short or obsolete.

On living or dead leaves of *Garrya elliptica* Dougl., San Rafael Hills, Marin Co., Calif., Jan. 1925, Lee Bonar, type, Univ. Calif. Herb. *653856;* near summit Mt. Tamalpais, Marin Co., Calif., March 13, 1926, Lee Bonar.

On leaves of *Garrya flavescens* Wats. var. *buxifolia* Jepson, 18 Mile Creek, Smith River, Del Norte Co., Calif., July 13, 1933, Lee Bonar and H. E. Parks.

Phyllosticta Phoradendri sp. nov.

Maculae orbiculares vel irregulares vel confluentes, brunneae, medio fusco; pycnidia tarde apparentia in regionibus mortuis, amphigena, crebra, subepidermalia, erumpentia, globosa, 125–200 μ diam., poroideo ostiolo, membranaceo pariete, atra; conidiophora simplicia, brevissima; sporidia bacilliformia, hyalina, continua, 2–3.5 × 1 μ.

Spots circular to irregular or confluent, brown with dark center; pycnidia appearing tardily in dead areas, amphigenous, crowded, subepidermal, erumpent, globose, 125–200 μ diameter; ostiole poroid; wall membranaceous, black; conidiophores simple, very short; spores bacilliform, hyaline, 1-celled, 2–3.5 × 1 μ.

In leaves of *Phoradendron flavescens* Nutt. var. *macrophyllum* Englem. on *Populus* sp., causing conspicuous killing of the leaves. Near Onyx, South Fork Kern River, Kern County, California, March 30, 1933, Lee Bonar, type, Univ. Calif. Herb. *653839*.

Cercosporella californica sp. nov.

Maculis sparsis, interdum confluentibus, ad 5 mm. diam.; brunneis ad fuscis, caespitulis hypophyllis albidis; mycelio superficiali nullis; conidiophoris fasciculatis, simplis, brevibus, nonseptatis, hyalinis, 15–20 × 4–5 μ, erumpentibus ex stromatis tuberculatis, subhyalinis; plerumque hypophyllis; conidiis cylindricis vel angustis-obclavatis, 6–8 (12) septatis, hyalinis, rectis vel curvatis, 40–70 (90) × 3–4 μ.

Spots scattered, sometimes confluent, up to 5 mm. diameter, brown to fuscous, white tufted below, superficial mycelium none; conidiophores fasciculate, simple, short, non-septate, hyaline, 15–20 × 4–5 μ, erumpent from tuberculate, subhyaline stromata; mostly hypophyllous; conidia cylindric or narrow obclavate, 6–8 (12) septate, hyaline, straight or slightly curved, 40–70 (90) × 3–4 μ.

On living leaves of *Rhus diversiloba* Torr. & Gray in California. San Mateo Co., Aug. 15, 1935, Lee Bonar, type, Univ. Calif. Herb. *653836;* Monterey Co., Aug. 1935, 1937, Lee Bonar; Pasadena Aug. 1894, McClatchie, distributed in Fungi Columbani No. *691* as *Cercospora Toxicodendri* Ellis.

This species differs from *Cercospora rhuina* Cooke & Ellis in the white flocculent surface of the fertile portions of the spots, and in the conidiophores which are simple, much shorter and distinctly hyaline, and in the hyaline conidia.

Chaetotrichum macrosporum sp. nov.

Mycelium in superficie ramulorum mortuorum maculas parvas formans vel continuum usque ad nonnulla cm.; hyphae superficiales vel corticem mortuum penetrantes, fuscae, nodosae irregularesque, ramosae; setae ex pulvinis hypharum basilarium erectae, dispersae vel saepius crebrae, tegeticulum atram formantes, rigidae, plerumque simplices, interdum ramosae, ad apicem obtusae, usque ad 1 mm. longae, 10–20 μ diam., breviores saepe in vertice sporam ferentes; hypharum basilarium rami immutati frequenter inverticibus sporas typo alio singillatim ferentes; sporae ramorum setosorum fusoideo-ellipticae, fuscae, septis 5–6, parietibus crassis, cellula terminali subhyalina, 30–40 × 10–14 μ; sporae ramorum hyphae immutatorum clavatae, fuscae, septis 8–12 (16), rectae vel paulo curvatae, ad basin valde attenuatae, ad apicem obtusatae, 50–125 × 12–22 (plerumque 75–90 × 15–18) μ, magnitudine et septis maxime variis.

On surface of dead twigs, in small spots or continuous over surface for several centimeters; hyphae on surface or penetrating dead bark, fuscous, gnarled and irregular, much branched; setae erect from cushions of basal hyphae, scattered or more commonly crowded to form a black mat, rigid, usually simple, obtuse at tip, up to 1 mm. long by 10–20 μ diameter, shorter ones frequently bearing a spore at the tip, undifferentiated branches of basal hyphae frequently bear a second type of spore singly at tips; spores on setose branched fusoid-elliptic, fuscous, 5–6 septate, thick-walled, terminal cell sub-hyaline, 30–40 × 10–14 μ; spores on simple hyphal branches clavate, fuscous, 8–12 (16) septate, straight or somewhat curved, strongly attenuated toward base, distal end obtuse, 50–125 × 12–22 (av. 75–90 × 15–18) μ, very variable as to size and septation (FIG. *f, g*).

On dead twigs of woody angiosperms, coastal California. Trinidad, Humboldt Co., California: on *Gaultheria Shallon* Pursh, May 10, 1931, H. E. Parks, type, Univ. Calif. Herb. *653859, Myrica californica* Cham., Jan. 1932, Parks *4043, Physocarpus capitatus* (Pursh) Ktze., Parks *4033,* and *Rubus spectabilis* Pursh, April 1932, Parks *4039.* Berkeley California: on *Prunus* sp., April 2, 1933, D. M. Brenneman.

The genus *Chaetotrichum* was erected by Sydow (Ann. Myc. **25**: 150. 1927). The type species *C. Solani* was described from living leaves of *Solanum* from Costa Rica. Our material agrees well with the generic characters listed by Sydow, but is distinct because of its habitat and variations in spore forms.

Strumella Simmondsiae sp. nov.

Maculis effusis, amphigenis, orbiculatis, depressis, atris, 1–4 mm. diam., cum marginibus distinctis, angustis, pallidis; sporodochiis minutis, tuberculatis, in pseudostromate hyphis fuscis, compactis, irregulariter ramosis; hyphis 4–6 μ diam.; conidiis raris, subglobosis, fuscis, minutis verrucosis, 7–10 × 5–7 μ; simpliciter cellulis rotundis, a hyphis irregulariter formatis.

Spots scattered, amphigenous, circular, depressed, black, 1–4 mm. diam., with a distinct, narrow, light margin (FIG. 2, *h*); sporodochia minute, tuberculate on a pseudostroma of compact, irregularly branched, dark brown hyphae; hyphae 4–6 μ diam.; conidia rare, subglobose, fuscous, minutely verrucose, 7–10 × 5–7 μ, simply rounded cells, irregularly formed from hyphae.

On living leaves, calyxes, and peduncles of *Simmondsia californica* Nutt., southern California, Arizona, and Lower California. Riverside Co., California: south of Hemit, H. S. Fawcett, May 7, 1939, type, Univ. Calif. Herb. *653866*. Aguanga, Fred Reed, Aug. 20, 1938, H. S. Fawcett, June 23, 1940.

Phanerogamic specimens of the host in the Dudley Herbarium, Stanford University, showed typical spots of this fungus on the following collections: San Diego Co., Calif.: Pampoto Mt. Springs, H. E. McMinn *1258;* Oneonota, A. C. Herre; Cottonwood Creek Valley, J. T. Howell *2968;* Sweetwater Dam, Geo. B. Grant; Otay River Wash, I. L. Wiggins *3243;* C. Epling and W. Robinson. Arizona: Tucson, I. L. Wiggins *6504;* Superstition Mts., Pinal Co. *8838,* and Apache Gap, Maricopa Co. *8807,* G. W. Gillespie; Santa Catalina Mts., J. J. Thomber *298*. Lower California: San Quintin, C. Epling and Wm. Stewart; Agua Caliente, S. B. and W. F. Parish *9*.

PHYSALOSPORA ILICIS (Schleich.) Sacc.

Collections of dead twigs of *Ilex aquifolium* L. made at Berkeley, California, were found to bear reproductive structures of three different fungi: *Physalospora Ilicis* (Schleich.) Sacc., *Macrophoma ilicella* (Sacc. & Penz.) Berl. & Vogl., and *Phoma ilicina* Ellis & Anderson. Since a number of imperfect forms have been suspected of being the conidial stage of *Physalospora Ilicis,* studies were undertaken to determine what possible relationship might exist between the three forms found growing on the same twigs.

Single spore isolations were made of the three types and the

cultures were grown under similar conditions on a variety of culture media. It was very soon apparent that the cultures from single ascospores of *Physalospora Ilicis* and those from single conidia of *Macrophoma ilicella* were indistinguishable when grown under similar conditions as to culture media and external conditions. The cultures from conidia of *Phoma ilicina* were distinctly different in appearance and habit of growth.

Cultures of the *Physalospora* and *Macrophoma* developed pycnidia with abundant conidia in twenty to twenty four days, most abundant on oatmeal agar. Extensive culturing and variations in the media and conditions under which the cultures were grown failed to produce the perithecial stage in cultures, but the consistent production of the *Macrophoma* stage proves that these two are stages in the same fungus. The distinctly different cultures and the production of typical pycnidia of *Phoma ilicina* likewise prove that it is not part of the life cycle of *Physalospora Ilicis*.

SPHAERULINA MYRIADEA (DC.) Sacc.

Parasitic on leaves of *Castanopsis sempervirens* Dudley, Sequoia National Park, California, H. E. Parks, June 1931. Causes conspicuous brown spotting of the leaves with numerous perithecia formed in the upper side of the leaves. This extends the known host range for this fungus.

BONORDENIELLA MEMORANDA Penz. & Sacc.

On dead flower stalks and capsules of *Agave deserti* Engelm. Mt. San Jacinto, Riverside Co., California, February 1938, H. E. Parks *6183*. This material agrees well with the original description and illustrations (Ic. Fung. Jav. *tab. 80, f. 4*) except that the conidiophores in this material are more irregular and torulose, whereas that from Java is described and figured as having longer and more regular conidiophores. This collection records a new locality and substratum for this species.

PEZIZA OCHRACEA Boud.

Scattered to slightly caespitose on clay soil under *Quercus agrifolia* Nee, Berkeley, California, D. G. Nelson, March 9, 1938 (FIG. 2, *c*).

This European species does not seem to have been reported from North America, but our material agrees well with Cooke's description. The suggestion by Bresadola (Icon. Myc. **25**: 1205) that this species be considered as a synonym of *Peziza pustulata* (Aleuria) (Hedw.) Pers. appears unjustified on the basis of the characters of both the spores and paraphyses.

POLYPORUS SULPHUREUS (Bull.) Fries.

This species has been found rather frequently during late summer and early autumn on stumps and bases of living trees of *Eucalyptus globulus* Labill. in central California. Extensive heart rot is caused in the lower trunk and large roots. One specimen was observed which matured in 15 days after emergence. In that time it developed into a three-tiered sporophore 12 × 18 inches, and weighed eight pounds when fresh. This fungus was reported on *Eucalyptus globulus* Labill. and *Eucalyptus amygdalina* Schau. in Argentina by C. Spegazzini. (Bol. Acad. Nac. Ci. Cordoba **28**: 267–406. 1926.) .

ENTYLOMA MELILOTI McAlpine.

Collected on *Melilotus indica* All., Monterey Co., California, J. M. Linsdale, May 24, 1941. This represents an extension of the known distribution of this species in the United States, earlier reports having recorded it from Alabama and Louisiana.

TROCHILIA ILICIS (Chev.) Crouan.

Collected on diseased or dead leaves of *Ilex Aquifolium* L., Eureka, Oct., 1933, Parks and Tracy *13108*, and Berkeley, California, Nov., 1940, Lee Bonar. This species is widely reported from Europe but apparently not common in America. It has been commonly listed and distributed as *Stegia Ilicis* Fries. The paraphyses are not the elongated, pointed type characteristic of the genus *Stegia*, but are the abruptly swollen type of *Trochilia*. Rehm (Rab. Krypt. Fl. **13**: 129–130.) has given the synonymy of *Trochilia Ilicis* (Chev.) Crouan and has pointed out the fact that *Trochilia Ilicis* Fries does not belong here.

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A SYNOPSIS OF ROZELLA AND ROZELLOPSIS

JOHN S. KARLING

In a previous paper on parasitism among chytrids, the author (1942) presented some of the developmental, cytological, and systematic problems which remain to be solved in relation to *Rozella*, and described three new species of this genus which attack chytridiacous fungi. In an attempt to clarify the taxonomic difficulties which have arisen from the discovery of new species since Cornu's and Fischer's times, a new genus, *Rozellopsis*, was proposed for the *Rozella*-like species with biflagellate, heterocont zoöspores. *Rozella* was retained in the original sense of Cornu for the posteriorly uniflagellate species, and *Pleolpidium* was reduced to the status of a synonym, as had been previously suggested by Sparrow (1938). Inasmuch as the number of *Rozella* parasites has increased considerably in the last decade and the descriptions of them are widely scattered in the literature, it is worth while for the sake of future studies to classify these species in light of present day knowledge and bring them together in one paper. The present contribution relates primarily to diagnoses of the known species of *Rozella* and *Rozellopsis* and presents again many of the problems which must be solved before these genera can be properly classified.

Differences in development between the monosporangiate and polysporangiate species of *Rozella* and their respective effects on the host have been recognized by all students of this genus. As early as 1872 Cornu showed that *R. Monoblepharidis*, *R. Rhipidii*, and *R. Apodyae* cause local hypertrophy of the host and asserted that their thalli form only one sporangium or resting spore. *Rozella septigena*, on the other hand, causes slight or no hypertrophy but induces septation of the infected hyphae. Its thallus, Cornu believed, functions as a sorus or plasmodium and divides into a number of segments which become separated by the host

septa, mature in basipetal succession, and develop into sporangia or resting spores. Fischer (1882) likewise noted and emphasized these differences but reported that the zoöspores of *R. septigena* and *R. simulans* are biflagellate and heterocont instead of posteriorly uniflagellate. He did not, however, attach so much significance to the number and position of the flagella as to the differences in development and effects on the host, and classified the species into two groups on the latter basis. Cornu's three monosporangiate species were placed in the "Sporangiumgruppe," while *R. septigena* and *R. simulans* were included in the "Septigenagruppe." Fischer later (1892) created a new genus, *Pleolpidium*, for the species of the first group, and limited *Rozella* to the members of the "Septigenagruppe" with *R. septigena* as the type species. In so doing he violated the rules of priority, as Sparrow has already pointed out, since *R. Monoblepharidis* was the first species described and must accordingly be accepted as the type species of the genus. Nevertheless, Fischer's classification of the species and his interpretation of *Pleolpidium* and *Rozella* were followed by most mycologists, who, however, emphasized the number, position, and relative lengths of the flagella as well as differences in development of the thalli.

Foust's (1937) discovery of a posteriorly uniflagellate septigenous species in *Allomyces* and the present author's recent observations of a similar species in *Achlya* sp., on the other hand, indicate that Cornu was correct in his account of the zoöspores of *R. septigena* and that Fischer was either wrong or had a different species at hand. As a consequence of Foust's discovery, Sparrow (1938) and the author (1942) have advocated the retention of *Rozella* in the original sense of Cornu, with *Pleolpidium* as a synonym. This reintroduces the problem of classification within the genus on the basis of differences in development and effects on the host. Sparrow revived Fischer's groups by translating the terms into English—*i.e.*, sporangium-group and septigena-group. Inasmuch as one of these terms refers to sporangia and the other to segmentation of the thallus and the effects on the host, they are not comparable and give the impression that sporangia are formed in one group and not in the other. There is obviously need here for more descriptive terms. The adjective nonseptigenous is more

appropriate than the term sporangium-group and may be profitably substituted. Monosporangiate and polysporangiate are other purely descriptive terms, which are non-committal as to whether or not the thallus undergoes segmentation.

The question of whether or not the thallus segments into several portions has not been conclusively settled. All students of the septigenous species have followed Cornu's belief and have expressed the opinion that the thallus is a sorus or plasmodium which cleaves into a number of segments which in turn become separated by host walls, mature in basipetal succession, and form sporangia. Although observations on living material strongly suggest this type of development, it has not been conclusively proven. If it should prove to be generally characteristic of the septigenous species, they will probably have to be segregated in a new genus. In our present state of knowledge, however, it is perhaps wiser to include them in *Rozella* with the monosporangiate species. This genus is accordingly presented in the original sense of Cornu and includes two groups of species. On the basis of its posteriorly uniflagellate zoöspores and intramatrical, holocarpic sporangia, it is provisionally included in the family Olpidiaceae. Further study of the septigenous members of the genus, however, may necessitate their removal from this family.

A new genus, *Rozellopsis,* was proposed by the author (1942) for the biflagellate, heterocont, *Rozella*-like species which have been reported in the literature from time to time. It was created primarily to include *Pleolpidium inflatum* Butler and a similar species which Miss Waterhouse (**1940**) found in *Phytophthora.* Both of these species appear to be monosporangiate and non-septigenous and fill the hypertrophied host cells so completely that their walls are indistinguishable from those of the host. However, nothing is known about their resting spores, and it is accordingly impossible to determine their relationship to other species.

Whether or not Fischer's biflagellate, heterocont *R. septigena* and *R. simulans* also belong in *Rozellopsis* is highly questionable. Tokunaga (1933) confirmed Fischer on the number and relative lengths of the flagella in *R. simulans,* which indicates the existence of septigenous species with zoöspores of this type. For this reason Fischer's *R. septigena* has been separated from Cornu's species of

the same name and is included with *R. simulans* provisionally in this genus. *Rozellopsis,* like *Rozella,* thus includes at present two groups of species. Its relation to other genera is uncertain, but for the time being it may be placed in the family Woroninaceae, which appears at present to be scarcely more than a dumping ground for biflagellate heterocont species. This interpretation is of course only temporary. Since all of its species are either doubtful or imperfectly known, further studies will doubtless invalidate many of the present day concepts.

ROZELLA Cornu, Ann. Sci. Nat. V. **15**: 150. 1872.
Pleolpidium A. Fischer, Rab. Krypt.-Fl. 1^4: 43. 1892.

Thallus intramatrical, holocarpic, more or less indistinguishable from but apparently immiscible with the host protoplasm; becoming invested with wall at maturity and forming one sporangium or resting spore, or cleaving (?) into several segments which become separated by host walls, mature in basipetal succession, and develop into sporangia or resting spores. Sporangia variable in size and shape, terminal or intercalary, hyaline and smooth, with one to six prominent or inconspicuous exit papillae which extend through the host wall; usually filling the host cell or hypertrophied portion of host hyphae completely; sporangium wall tightly pressed against, seemingly fused with, and usually indistinguishable from that of the host. Zoöspores numerous, hyaline, pyriform, ellipsoidal, and obclavate, with or without one to several minute globules; posteriorly uniflagellate, occasionally bi- and multiflagellate; flagellum approximately 4 to 6 times as long as spore body; usually swirling in the sporangium before emerging fully formed and swimming away; motility rapid, jerky and darting; contents flowing into host cell through an infection tube during germination, leaving the empty zoöspore case on the outside. Resting spores numerous or solitary in host cell, variable in size, shape, and color, smooth, warty or spiny; usually formed in the same portions of the host as the zoösporangia but lying free within and separate from the host wall; protoplasm coarsely granular with a large central vacuole or globule of hyaline substance; producing zoöspores directly in germination.

NONSEPTIGENOUS, MONOSPORANGIATE SPECIES

ROZELLA MONOBLEPHARIDIS Cornu, l.c., 148. *pl. 4, fig. 13–18.*
Pleolpidium Monoblepharidis A. Fischer, Rab. Krypt.-Fl. 1^4: 44. 1892.

Sporangia intercalary in host hyphae, ovoid, truncate, or barrel-shaped with one short exit papilla; wall distinct from that of host at ends of sporangia. Zoöspores unknown. Resting spores spherical, spiny, and brown; contents coarsely granular, including a large central refractive globule; germination unknown.

Parasitic in *Monoblepharis polymorpha* in France (Cornu, l.c.) and Germany (Minden, 1911), causing large local swellings in the mycelium.

This is the type species of *Rozella* and has been reported but once since Cornu's time. Nothing is known about its zoöspores or the dimensions of the sporangia and resting spores.

ROZELLA RHIPIDII Cornu, l.c., p. 153. *pl. 5, fig. 1–9.*

R. Rhipidii spinosa Cornu, l.c.

Pleolpidium Rhipidii (Cornu) A. Fischer, Rab. Krypt.-Fl. **1**[4]: 44. 1892.

P. Ariosporae (Cornu) Minden, Krypt.-Fl. Mark Brand. **5**: 252. 1911.

Sporangia terminal, obpyriform or broadly ellipsoidal with a terminal exit papilla occupying the same position as that of a normal host sporangium; wall of parasite indistinguishable from that of host. Zoöspores kidney-shaped, arched, oval or ellipsoidal, containing several minute granules. Resting spores spherical, spiny, golden-brown or reddish in color; contents coarsely granular; germination unknown.

Parasitic in the horny and smooth sporangia of *Ariospora spinosa* in France (Cornu, l.c.) and Germany (Minden, l.c.) causing slight hypertrophy.

ROZELLA APODYAE Cornu, l.c. p. 161. *pl. 5, fig. 10–14.*

R. Apodyae brachynematis Cornu, l.c.

Pleolpidium Apodyae (Cornu) Fischer, l.c. p. 45.

Sporangia terminal, obpyriform, oval and ellipsoidal with an apical exit papillae; wall of parasite indistinguishable from that of host. Zoospores apparently of the same size, shape, structure and behavior as those of the previous species. Resting spores spherical, spiny, golden-brown or reddish in color; contents coarsely granular and vacuolate; germination unknown.

Parasitic in the terminal sporangia of *Apodya brachynema* in France, causing slight hypertrophy.

As is obvious from the above diagnosis, this species is identical with *R. Rhipidii* except for slightly longer spines on the resting spores, according to Cornu, but it does not attack the latter's host, *Ariospora spinosa,* even when both hosts are growing together. It may possibly be only a physiological variety of *R. Rhipidii.*

ROZELLA IRREGULARIS (Butler) Sparrow, Mycologia **30**: 377. 1938.

P. irregulare Butler, Mem. Dept. Agr. India **1**[5]: 123. *pl. 8, fig. 1–12.* 1907.

Sporangia terminal and intercalary, spherical and irregular in shape, averaging 23 μ in diam., with one exit papilla. Zoöspores elongately obclavate with a bright globule. Resting spores lying free in hypertrophied portion of host hypha, spherical, 11–15 μ, brown, smooth to spiny; germination unknown.

Parasitic in and causing marked local hypertrophy of the hyphae of *Pythium vexans* in England (Butler, l.c.) and *P. monospermum* in Japan (Tokunaga, 1933).

According to Butler, the presence of the parasite may lead to the formation of cross walls in the hyphae and induce abnormal branching of the hypertrophied portions.

ROZELLA CUCULUS (Butler) Sparrow, l.c.

Chytridium simulans Dangeard, Le Bot. **5**: 21. *fig. 1A–1Q.* 1896. (Not *Chytridium simulans* de Bary and Woronin, 1865. p. 262.)

Pleolpidium cuculus Butler, l.c., p. 124. *pl. 7, fig. 22–25.*

Sporangia terminal in sporangia of the host, from which they can scarcely be distinguished, or intercalary in the mycelium, spherical, ovoid, or pyriform, 19.2–24 μ, with one exit papilla. Zoöspores elongately obclavate or ovoid with one refractive globule. Resting spores rare, solitary and free, spherical, 12–18 μ, smooth, brown to pale-yellow in color; contents granular, including a large central refractive globule; germination unknown.

Parasitic in *Pythium* sp. and *P. intermedium* in France and England (Dangeard and Butler, l.c.) and *P. monospermum* in Japan (Tokunaga, 1933) causing hypertrophy of the hosts.

Whether or not Dangeard's fungus is identical with Butler's species, is, of course, uncertain, because the former worker described only sporangia and zoöspores. Butler reported only terminal sporangia, but Dangeard and Tokunaga found intercalary ones as well. Sparrow believed that *R. cuculus* probably includes *P. tuberculorum* Vuill. also.

ROZELLA BLASTOCLADIAE (Minden) Sparrow, l.c.

Rozella sp. Thaxter, Bot. Gaz. **21**: 50. 1896.

Pleolpidium sp. Petersen, Ann. Myc. **8**: 555. *fig. XXVI c–d.* 1910.

P. Blastocladiae Minden, l.c., p. 253. Falck's Mykol. Untersuch. Ber. **1**: 253. *pl. 4, fig. 33.* 1923.

Sporangia terminal, of the same shape but smaller than normal sporangia of the host, with an apical exit papilla; collapsing when empty. Zoöspores unknown. Resting spores almost spherical, brown, spiny, contents granular; germination unknown.

Parasitic in the sporangia of *Blastocladia Pringsheimii* in Maine, U. S. A., Denmark, and Germany without causing apparent hypertrophy.

This species was first observed by Thaxter in America, but because of the scantiness of material, he merely designated it as a *Rozella* parasite. Petersen referred it to the genus *Pleolpidium* but thought that it might be a species of *Olpidium*. Minden's observations and description were likewise very limited as to many of the critical developmental stages.

ROZELLA POLYPHAGI Sparrow, l.c.

Pleolpidium Polyphagi Sparrow, Trans. Brit. Mycol. Soc. **18**: 215. 1933.

Pleolpidium (*Rozella*) *Polyphagi* Sparrow, Jour. Linn. Soc. **50**: 426. *pl. 14, fig. 19, 20.* 1936.

Sporangia spherical, 20–48 μ, with 2 to 6 prominent exit papillae, 4 to 8 μ in diameter. Zoöspores narrowly ovoid, 2–3 $\mu \times$ 1.5–2 μ, with one refractive globule. Resting spores unknown.

Parasitic in *Polyphagus Euglenae,* Cambridge, England, causing marked hypertrophy of the prosporangia.

ROZELLA MARINA Sparrow, Mycologia **30**: 377. 1938.
Pleolpidium (*Rozella*) *marinum* Sparrow, Biol. Bull. **70**: 256. *fig. 32, 33.* 1936.

Sporangia spherical, 30–45 μ, with 1 to 3 exit papillae. Zoöspores ellipsoidal, 3 $\times$ 2 μ, aguttulate. Resting spores unknown.

Parasitic in *Chytridium Polysiphoniae,* Woods Hole, Mass., causing hypertrophy of the sporangia.

ROZELLA CLADOCHYTRII Karling, Torreya **41**: 105. 1941. Am. Jour. Bot. **29**: 25. 1942.

Sporangia solitary in a host cell, spherical, 10–40 μ, ovoid, ellipsoid, 10–15 μ $\times$ 15–35 μ, pyriform, and obclavate, hyaline and smooth with one to three exit papillae; wall of sporangium usually indistinguishable from that of host cell. Zoöspores obclavate, 3.3–5 μ $\times$ 1.8–2 μ, aguttulate; rarely bi- and multiflagellate as the result of unequal cleavage; flagellum 14 μ long; emerging fully formed in a stream from the exit papillae and becoming actively motile in a few seconds. Resting spores faintly yellow, oval, spherical, 8–22 μ, with a large central vacuole and coarsely granular cytoplasm; wall 1–1.8 μ thick, smooth or spiny, spines 1.5–3 μ long; transformed directly into a zoösporangium in germination and forming zoöspores.

Parasitic in *Nowakowskiella profusum, N. elegans, N. ramosum, Cladochytrium replicatum, C. crassum,* and *C. hyalinum,* Bastrop, Texas, causing slight to marked hypyertrophy.

Attempts by the author (1941, 1942) to infect *Endochytrium operculatum, Rhizophlyctis Petersenii, Rhizophidium globosum, Olpidium gregarum, Catenochytridium carolineanum, Diplophlyctis intestina, Entophlyctis heliomorpha, E. texana, Saprolegnia* sp., *Achlya* sp., and *Pythium de Baryanum* with this parasite have failed.

ROZELLA ENDOCHYTRII Karling, Torreya **41**: 106. 1941. Am. Jour. Bot. **29**: 31. 1942.

Sporangia solitary in a host cell, spherical, 15–200 μ, oval, elongate, pyriform and irregular, depending on the size and shape of the host cell; wall of sporangium usually indistinguishable from that of the host, hyaline and smooth with one to several exit papillae, 2–6 μ high. Zoöspores obclavate, 3.4–4 μ $\times$ 1.5 μ, aguttulate

but with optically denser apical and basal regions which give them a characteristic appearance; swirling in the sporangium before dehiscence; emerging in a stream and becoming actively motile in a few seconds. Resting spores unknown.

Parasitic but not causing apparent hypertrophy in sporangia of *Endochytrium operculatum,* Austin, Texas.

This species appears to be restricted to one host, because extensive attempts to infect the fungi used in the study of *R. Cladochytrii* have failed.

ROZELLA RHIZOPHLYCTII Karling, Am. Jour. Bot. **29**: 32. 1942.

Sporangia solitary, filling the sporangia of the host and conforming to their size and shape, spherical, 20–110 μ, oval, and irregular with 1 to 4 exit papillae which usually project out of the short necks of the host; wall of sporangium usually indistinguishable from that of host cell. Zoöspores hyaline, broadly pyriform, 2.5–3 $\mu \times$ 1.5–2 μ, with a slightly tapering anterior end and a minute dense body in the cytoplasm; occasionally bi- and multiflagellate; flagellum 16–18 μ long; swirling in the sporangium before emerging; darting about in swimming, rarely becoming amoeboid. Resting spores faintly yellow, oval and spherical, 14–18 μ in diameter, with a large central vacuole and coarsely granular protoplasm; wall spiny, 1.8 μ thick, spines 1.5–2 μ long; apparently transformed directly into a zoösporangium in germination and forming zoöspores.

Parasitic in *Rhizophlyctis Petersenii,* Austin, Texas, without causing apparent hypertrophy or septation of the host cells.

This species also appears to be limited to one host, since all efforts to transfer it to the chytridiacous and oomycetous fungi used in the study of the two previous species have failed. It may possibly be identical with *Rozella* sp., described by Ward (**1939**) in *Rhizophlyctis rosea.*

Rozella laevis sp. nov.

Sporangia solitary, partly or completely filling hypertrophied portions of the host hyphae, variable in size and shape, spherical, 20–52 μ, clavate, 10–20 $\mu \times$ 30–112 μ, broadly and elongately pyriform with 1 to 3 exit papillae, 3–4 μ in diam. by 2–3 μ in height. Zoöspores hyaline, with a globular spot which is not markedly refractive, obclavate to pyriform, 1.5–1.8 $\mu \times$ 2.9–3.3 μ; occasionally

bi- and multiflagellate, flagellum 10–12 μ long. Resting spores spherical, 11–18 μ, oval, elongate or obpyriform with a large central vacuole and coarsely granular cytoplasm; wall smooth and hyaline, 1.5–2 μ thick; germination unknown.

Parasitic in *Pythium gracile*, New Kent County, Virginia, U. S. A., causing marked hypertrophy.

This species appears to be closely related to *R. cuculus*, but whether or not they are identical is uncertain. The resting spores of both species are similar in size and smooth-walled, but differ in color. The swellings caused by *R. laevis* are larger and may become divided by a thick cross or tangential wall, but no segmentation of the thallus occurs during the process of cell division. Unfortunately no cross inoculations were made with this species to determine its host range.

Rozella Barrettii sp. nov.

Pleolpidium sp., Barrett, Phytopath. **24**: 1138. 1934.

Sporangia terminal and intercalary, of the same size as and indistinguishable from the host sporangia until zoöspores are formed; opening by one or more exit papillae which project through the host wall. Zoöspores numerous and minute. Resting spores unknown.

Parasitic in *Phytophthora cactorum* in California, U. S. A., causing local spherical swellings in the host hyphae as well as completely filling the sporangia.

This species is incompletely known and has been reported only in a preliminary manner. Barrett did not measure the size of the zoöspores nor describe the number, length, and position of the flagella, and until more is known about the zoöspores and resting spores, its identity and relation to other species of *Rozella* remain doubtful. Its occurrence on *Phytophthora* suggests that it may possibly be related to Miss Waterhouse's parasite and belong in *Rozellopsis*.

In connection with this synopsis of the monosporangiate species, it may be noted that Schultz-Danzig (**1923**) recorded an unidentified *Rozella* (*Pleolpidium*) species in *Mougeotia* sp. His description, however, is very meager, and it is not certain that the parasite belongs in this genus. If so, it is the first record of *Rozella* in

algal hosts. Sparrow (1936) has expressed the opinion that the parasite which he described as *Pseudolpidium Pythii* may also be a species of *Rozella*.

SEPTIGENOUS POLYSPORANGIATE SPECIES

ROZELLA SEPTIGENA Cornu, l.c., p. 163. *pl. 6.*

Sporangia in a linear row, up to 25 in delimited segments of the host hyphae, of the same size and shape as the hyphal segments, barrel-shaped, cylindrical, or ellipsoidal, with 1 to 2 apical or lateral exit papillae. Zoöspores hyaline with a small darker area or spot near the base, elongately clavate, 1.5–2 $\mu \times$ 3–4 μ, arched, and oval, occasionally large and biflagellate; flagellum 12–14 μ long. Resting spores usually solitary in segments of the main axis or the short swollen side branches or "false oögonia," spherical, 14–20 μ, brown, spiny, spines 2 μ long; contents coarsely granular, including a large refractive globule; producing zoöspores directly in germination.

Parasitic in *Saprolegnia* speries in Germany (Nägeli, **1846**; Minden, l.c.); *Achlya racemosa, A. polyandra, Saprolegnia* sp., and *S. spiralis* in France (Cornu, l.c.; Dangeard, **1890**); *A. polyandra* in Russia (Sorokin, **1883, 1889**); *Saprolegnia* sp., in Roumania (Constantineau, **1901**); *Achlya* sp. and *Saprolegnia* sp. in New York, U. S. A., England and Czechoslovakia (Sparrow, **1932, 1936**; Cejp, **1934**), causing slight hypertrophy and septation of the host.

This species was apparently first observed by Nägeli who regarded its sporangia as a modification of the sporangia of what is now recognized as *Olpidiopsis*. The sporangia and zoöspores which Pringsheim (1860) described in *Achlya dioica* and which were subsequently believed to relate to *R. septigena* have recently been shown by Couch (**1939**) to be those of another fungus, *Pringsheimella dioica*. Whether or not the species described by Fischer (1882) as *R. septigena* is identical with Cornu's species and belongs here is obviously open to question. Fischer reported that his fungus is limited in host range to species of *Saprolegnia* and has biflagellate, heterocont, 4 $\mu \times$ 6–8 μ, zoöspores which are approximately twice the size of those figured by Cornu. The latter worker also found a few large posteriorly biflagellate zoö-

spores in *R. septigena,* but he regarded them as abnormal. Cornu's observations were subsequently confirmed by Sorokin. As the author has pointed out previously (1942), Fischer may have attached too much significance to these large biflagellate zoöspores and regarded them as typical of Cornu's *R. septigena,* or he actually had another fungus in his cultures. Most mycologists have doubted the latter possibility, but it takes on greater significance in light of Tokunaga's discovery of large, biflagellate, heterocont zoöspores in a similar species, *R. simulans,* which is reported to occur only on *Achlya.* I am accordingly excluding Fischer's *R. septigena* from consideration here and transferring it provisionally with *R. simulans* to the genus *Rozellopsis.*

Cornu's observations on the zoöspores of *R. septigena* are confirmed by my observations on an *Achlya*-inhabiting, septigenous *Rozella* species with obclavate, 1.8–2 $\mu \times$ 3–4 μ, posteriorly uniflagellate zoöspores and spherical, 14–20 μ, brown, spiny resting spores. The latter germinated within two weeks and produced similar zoöspores in the manner described for *R. Allomyces* and *R. Cladochytrii.* These observations further confirm the reports of Cornu and subsequent workers on the existence of a posteriorly uniflagellate septigenous parasite in species of *Achlya.*

ROZELLA ALLOMYCIS Foust, Jour. Elisha Mitchell Sci. Soc. **53**: 198. *pl. 22, 23.* 1937.

Sporangia terminal in host hyphae, separated by the formation of cross and tangential walls by the host and maturing in basipetal sequence, usually 1 to 5 in a row, barrel-shaped, 12–20 $\times$ 20–40 μ, usually with one exit papilla, 1.3 μ high. Zoöspores ovoid, 3–4 μ in diam., tapering at the anterior end and containing one refractive globule; flagellum about four times the length of the spore body. Resting spores formed later than the sporangia and below them in swollen segments of the host hyphae, 1 to 16 in a segment, spherical, 12–20 μ, yellowish- to reddish-brown in color with a 0.5 μ thick spiny wall, spines 1.3 μ long; contents coarsely granular, including a large central globule of hyaline material; producing zoöspores directly in germination.

Parasitic in *Allomyces arbuscula,* Chapel Hill, North Carolina, causing hypertrophy and septation of the hyphae.

This species appears to be very similar to *R. septigena* Cornu, but whether or not it will infect the latter's hosts is not known. Unfortunately, Foust did not make extensive inoculation experiments with other species of water moulds.

ROZELLOPSIS Karling, Am. Jour. Bot. **29**: 33. 1942.

Thallus intramatrical, holocarpic, more or less indistinguishable from but apparently immiscible with the host protoplasm; becoming invested with a wall at maturity and forming one sporangium, or cleaving (?) into several segments which become separated by host walls, mature in basipetal succession, and develop into sporangia or resting spores. Sporangia terminal or intercalary, variable in size and shape, with one to several exit papillae which extend through the host wall; usually filling the host sporangia or the hypertrophied portions of the hyphae completely; sporangium wall tightly pressed against, seemingly fused with, and usually indistinguishable from that of the host. Zoöspores slightly variable in size and shape, with one to several minute globules, biflagellate and heterocont, shorter flagellum usually extending forward and the longer one backward in swimming; zoöspores swirling in the sporangium before emerging fully formed and swimming away; contents flowing into host cell through an infection tube in germination, leaving the empty zoöspore case on the outside. Resting spores unknown in monosporangiate species; solitary in septigenous species, lying free within host cell and separate from host wall, variable in size, brown, and spiny; protoplasm coarsely granular, including a large vacuole or globule of hyaline material; germination unknown.

NONSEPTIGENOUS MONOSPORANGIATE SPECIES

ROZELLOPSIS INFLATA (Butler) Karling, l.c.

Pleolpidium inflatum Butler, l.c., pp. 126, 127. *pl. 7, fig. 17–21.*

Sporangia terminal, spherical, up to 85 μ in diam., oval, or pyriform with one to several exit papillae. Zoöspores reniform, kidney-shaped with the short flagellum attached at the anterior end and the longer one at the sides; swimming smoothly in long curves. Resting spores unknown.

Parasitic in *Pythium intermedium*, Antibes, France, causing marked hypertrophy of the host sporangia.

ROZELLOPSIS WATERHOUSEII Karling, l.c.

Sporangia terminal, spherical, up to 74 μ in diam., clavate, oval, or obpyriform with 1–3 apical or lateral exit papillae. Zoöspores pyriform, 5–8 μ long with a few small refringent granules in the center or near the posterior end; flagella apparently laterally inserted (?); zoöspores active for 24 hours or more, or rounding up and encysting.

Parasitic in *Phytophthora cryptogea* and *P. megasperma,* London, England, causing occasional hypertrophy of the host sporangia and supporting hyphae.

Miss Waterhouse discovered this parasite in material collected from the Hogsmill River, a Surrey tributary of the Thames, and has given an excellent account of its development and infection of the host. She succeeded in inoculating *P. megasperma* with it, but all attempts to infect *Rhipidium continuum* and *R. americanum* were unsuccessful. This species differs from *C. inflatum* by its pyriform zoöspores and the fact that it causes only slight hypertrophy of the host. Because of its similarity in other respects to Butler's species, Miss Waterhouse, however, would not diagnose is as a new species. I have accordingly named it in her honor.

SEPTIGENOUS POLYSPORANGIATE SPECIES

ROZELLOPSIS SEPTIGENA (Fischer) Karling, l.c.

Rozella septigena Fischer, Jahrb. Wiss. Bot. **13**: 321. *pl. 14, fig. 19; pl. 15.* 1882. (Not *R. septigena* Cornu, 1872.)

Sporangia up to 20 in a linear row in delimited segments of the host hyphae, of the same size and shape as the hyphal segments, with 1–2 apical or lateral exit papillae. Zoöspores elongately pyriform, 4 $\mu \times$ 6–8 μ, hyaline, with a minute central refractive spot, biflagellate and heterocont; short flagellum anteriorly attached, long flagellum lateral. Resting spores solitary in segments of the hyphae or in short swollen side branches or "false oögonia," spherical, 20 μ, with a hyaline endospore and spiny brown exospore, spines 2 μ long, contents coarsely granular, including a large refractive globule; germination unknown.

Parasitic in *Saprolegnia monoica* and *S. Thureti* in Germany (Fischer, l.c.; Minden, l.c.), causing slight hypertrophy and septation of the host hyphae.

Fischer's attempts to inoculate *Achlya* with this species failed, and he accordingly concluded that it is limited in host range to *Saprolegnia*. His results have never been confirmed experimentally. For further discussion of this species, see *Rozella septigena* Cornu.

ROZELLOPSIS SIMULANS (Fischer) Karling, l.c.

Rozella simulans Fischer, l.c., p. 321; Minden, l.c., p. 271, *fig. 11a;* Tokunaga, Trans. Sapporo Nat. Hist. Soc. **13**: 25. *pl. 2, fig. 12–14.* 1933.

Sporangia up to 15 in a linear row in delimited segments of the host hyphae, cylindrical, barrel-shaped, 25–90 $\mu \times$ 60–250 μ, with 1–2 apical or lateral exit papillae. Zoöspores elongate, ellipsoidal, 2.4 $\mu \times$ 6 μ, hyaline with a small refractive spot and two unequal flagella at the anterior end. Resting spores solitary in short swollen side branches or "false oögonia," of the same size, shape, content, and appearance as those of the previous species; germination unknown.

Parasitic in *Achlya polyandra* and *A. racemosa* in Germany (Fischer, l.c., Minden, l.c.), *Achlya* sp. in Switzerland (Mauricio, **1895**), and *A. flagellata* in Japan (Tokunaga, l.c.), causing slight hypertrophy and septation of the host hyphae.

According to Fischer, this species is similar to *R. septigena* and differs only by its limitation in host range. Subsequent workers who reported its occurrence, however, did not make cross inoculations but accepted Fischer's observations without question. Inasmuch as Minden apparently did not determine the number, relative lengths, and position of the flagella of his fungus, it is just as probable that the resting spores which he figured related to *R. septigena* as to the present species. Likewise, it is not certain that Tokunaga's species is *R. simulans,* although the host reactions and sporangia are similar. He figured the zoöspores as anteriorly biflagellate and narrow, while Fischer described them as large and exactly similar to those of *R. septigena* with the short flagellum anteriorly attached and the long one lateral. Consideration, however, must be given to the difficulty of determining the exact position of the flagella on active zoöspores, and it is possible that these differences in observations are due to this factor. If this species

is identical to *R. septigena*, as Fischer maintained, and will infect only *Achlya*, it may probably be a physiological variety of the former species.

SUMMARY

Rozella is interpreted in the original sense of Cornu and includes thus only species with posteriorly uniflagellate zoöspores. *Pleolpidium* Fischer accordingly becomes a synonym of this genus. In its present status *Rozella* includes thirteen nonseptigenous monosporangiate species and two septigenous, polysporangiate species. *Rozellopsis* has been created for all known *Rozella*-like species with biflagellate heterocont zoöspores. It includes at present two imperfectly known nonseptigenous monosporangiate members and two questionable septigenous polysporangiate species.

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SEXUALITY IN ALLOMYCES CYSTOGENUS

JAMES MCCRANIE

(WITH 1 FIGURE)

The genus *Allomyces* has been subdivided by Emerson (**1941**) into three subgenera on the basis of the type of life cycle. Those forms in which there is an alternation of an asexual plant, bearing zoösporangia and resistant sporangia, with a sexual one, bearing paired male and female gametangia, are included in the subgenus *Euallomyces*. Some isolates have repeatedly failed to produce a sexual generation. The single type of thallus in these forms corresponds in its general morphology to the asexual plant of members of the subgenus *Euallomyces, i.e.,* bearing zoösporangia and resistant sporangia. Such forms are segregated into a subgenus, *Brachyallomyces*. The third subgenus, *Cystogenes,* likewise, has only one generation. Its thallus is similar to that of *Brachyallomyces* and to the asexual plant of *Euallomyces*. Here, however, according to Emerson, the zoöspores released upon the germination of the resistant sporangia are biflagellate instead of uniflagellate as in *Euallomyces* and *Brachyallomyces* and, instead of developing directly into thalli, they encyst and later give rise to a tetrad of uniflagellate zoöspores each of which then develops into an asexual thallus.

In the absence of cytological evidence it is not possible to interpret with certainty the *Cystogenes* life history. Emerson points out the close similarity between the biflagellate primary R.S. zoöspores (zoöspores from the germinating resistant sporangia) and the biflagellate planozygotes of *Euallomyces* and, in an attempt to explain this similarity, suggests that sexual fusions may take place inside the resistant sporangia during their germination. In other words, the primary R.S. zoöspores might actually be zygotes. The production of secondary R.S. zoöspores (zoöspores produced in the cysts) in groups of four indicates that meiotic divisions may

occur in the formation of these spores in the cysts. If these suggestions are correct, the thallus of *Cystogenes* is haploid.

It became clear to the writer while working on the cytology of the genus that this inference is improbable for reasons which will be presented when the cytological results are published. But aside from cytological evidence, the improbability of such an interpretation was realized from morphological observations. In the first place, the writer has never found the primary biflagellate R.S. zoöspores reported by Emerson as coming directly from the resistant sporangia. In studying the germination of the resistant sporangia of *Allomyces cystogenus*[1] (Emerson's Burma 1B isolate) the immediate product of germination has always been non-flagellate spores which encyst in a group immediately after discharge. This absence of biflagellate primary R.S. zoöspores eliminates the reason for supposing that sexual fusions might occur in the germinating resistant sporangia. In the second place, the cysts produced by the non-flagellate spores are quite variable in size and produce from one to several zoöspores. This fact, that only one secondary R.S. zoöspore may be formed in certain of the smaller cysts, decreases the probability that a meiotic division occurs in the formation of the secondary R.S. zoöspores. In the third place, the obvious difference in size between secondary R.S. zoöspores of *A. cystogenus* and the zoöspores from its zoösporangia early led the writer to doubt the correctness of Emerson's suggestions. If the thallus were haploid, both these types of zoöspores would necessarily be haploid. But if the two types of zoöspores contain the same chromosome number, it seems quite anomalous that the zoöspores from the zoösporangia are typically twice as large as the secondary R.S. zoöspores.

As a result of these observations, a study of the behavior of the secondary R.S. zoöspores was made. In this study resistant sporangia that had been separated from the thallus and thus freed of any other possible gamete-producing structure were germinated in water on a slide under a supported cover slip and watched under the microscope. The resistant sporangia of this strain of *A. cysto-*

[1] The writer is indebted to Dr. Emerson for his kindness in supplying this fungus and others.

genus germinate quite readily after they have been allowed to reach full maturity. Since they are partially deciduous, large numbers of the resistant sporangia may be collected on a cover slip placed underneath a mass of thalli. They may also be separated by allowing the complete desiccation of the thalli and zoösporangia.

Fully mature resistant sporangia usually begin to germinate in a short time after being placed in fresh water. The outer, thick wall

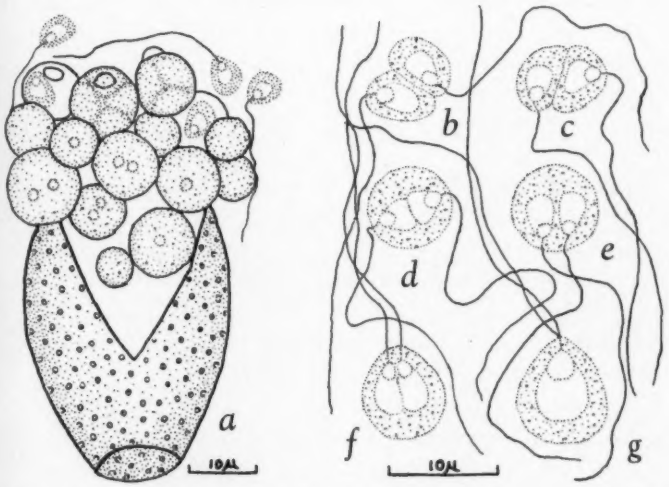

FIG. 1. *a*, germinated resistant sporangia of *Allomyces cystogenus* showing spores in the encysted stage at the point of discharge and isogametes from the germinating cysts; *b* and *c*, semi-amoeboid gametes just before fusion; *d*, *e* and *f*, stages in the orientation and fusion of the nuclear caps; *g*, biflagellate zygote.

cracks open irregularly and the sporangial content almost doubles in volume. The protoplasm cleaves into blocks of varying size, most of which contain more than one nucleus. These cleavage products are discharged from the sporangium through dehiscence papillae. In the writer's observations these structures have never been found to be flagellate. They usually encyst in a group at the point of discharge (FIG. 1, *a*). Immediately, or after a quite variable period, they proceed to the production of the secondary swarmers.

Careful observation of these isogamous swarmers produced in the cysts resulted in the noting of their actual copulation. In the process, semi-amoeboid gametes, heretofore referred to as secondary R.S. zoöspores or swarmers, come together in pairs and crawl over each other with amoeboid movements (FIG. 1, *b* and *c*) immediately after discharge from the cysts or after a preliminary swarming period. In a few minutes after contact, sometimes only a few seconds, it is apparent that the amoeboid movements have become those of only one individual rather than two. Shortly after this becomes apparent, the amoeboid movements cease altogether and the zygote jerks itself into a compact form (FIG. 1, *g*) and swims away by means of its two flagella. (Figure 1, *d*, *e*, and *f* show stages in the fusion of the nuclear caps.) In general morphology and size these biflagellate zygotes are identical with the uniflagellate zoöspores produced in the zoösporangia. Furthermore, both germinate into the same type of thallus—the typical *Cystogenes* plant. Since the zygote is necessarily diploid, it is obvious that the *Cystogenes* thallus is, likewise, diploid. It is possible that this fusion may occur in some strains and not in others, inasmuch as my observations are still limited to this one strain.

Although the copulation of isogametes has previously been reported in the Blastocladiaceae, in *Blastocladiella* by Harder and Sorgel (**1938**) and in *Sphaerocladia* by Stüben (**1939**), this is the first description of this type of sexuality in the more highly developed genus *Allomyces*. To heterogamy, established in the genus by Kniep (**1929**) in *Allomyces javanicus* and confirmed by Hatch (**1933**) in *A. arbusculus*, is thus added isogamy.

At first thought it might be concluded that *Allomyces cystogenus* with its isogamous sexuality is a connecting link between isogamous *Blastocladiella* and *Sphaerocladia* and heterogamous *Allomyces javanicus* and *A. arbusculus*. All four of the latter, however, have alternation of generations in which the sexual and asexual plants are equally conspicuous. But there is not such an alternation in *A. cystogenus*, the gamete-producing structures being merely cysts. It seems more likely, therefore, that this fungus is merely a "brachy-" form derived from a *Euallomyces* type in which the gametophyte generation has been reduced to a cyst.

In conclusion, the writer expresses his appreciation of the guidance of Dr. L. E. Wehmeyer and Dr. F. K. Sparrow in the present study.

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NOTES AND BRIEF ARTICLES

"Myriangiales Selecti Exsiccati," Fascicle 1.[1]—In the contribution, "Myriangiales Selecti Exsiccati," presented at the Primeira Reunião Sul-Americana de Botanica held in Rio de Janeiro in October 1938, the authors, Anna E. Jenkins, U. S. Department of Agriculture, Washington, D. C.; and A. A. Bitancourt, Instituto Biologico de São Paulo, Brazil, announce a new series of exsiccati so entitled.[2] Fascicle 1, prepared in connection with the meeting, has now been issued from São Paulo under the date of December 1940. It is based upon the article by the same authors entitled "Ilustrações das doenças causadas por *Elsinoë* e *Sphaceloma* conhecida na America do Sul até Janeiro de 1936." (Arqu. Ind. Biol. São Paulo **10**: 31–60, 1939), and a copy of this publication accompanies each fascicle. Following the plan for the series, the fascicle contains fifty specimens and is issued in 10 sets. The fifty specimens are enumerated in the announcement of this special new set of exsiccati.

All but two of the fourteen species treated in the above-mentioned article of 1936 are represented in the fascicle. The two species lacking are *Elsinoë amazonica* and *E. calopogonii*, of which no specimens for distribution are available. Type collection material is included of *E. australis, E. randii, Sphaceloma genipae* and *S. terminaliae,* as well as material of *E. fawcettii* from the type locality. The other seven species in the fascicle are *E. ampelina, E. piri, E. veneta, S. mattirolianum, S. perseae, S. populi,* and *S. rosarum.*

With the exception of two specimens bearing the date 1925, all of the material in Fascicle 1 was gathered during the 10-year period 1931–40. The collectors are chiefly present day workers in mycology and plant pathology in South America, as well as in several cases those from the United States who have been sta-

[1] This note was prepared by the authors of this set of exsiccati.

[2] The article referred to is in press in volume 4 of the Annals of this meeting.

tioned in South America for a time. Among the specimens gathered especially for the fascicle are those of the little known species, *Sphaceloma populi*, from the same parts of Argentina and Chile where this fungus was discovered in these countries by Spegazzini, in 1880 and 1909, respectively. As previously explained, this species was originally described from Italy, in 1878, as *Hadrotrichum? populi* Sacc.

One set of Fascicle 1 has been deposited in the Farlow Cryptogamic Herbarium, Harvard University, Cambridge, Massachusetts, and another in the New York Botanical Garden, New York, New York, U. S. A., while one set has been reserved for the Instituto Biologico, São Paulo, Brazil, and one for the U. S. Department of Agriculture, Washington, D. C. The remaining sets are held in reserve for similar deposit in other representative mycological herbaria when world conditions permit.

Announcement

Since the publication of the first edition of The North American Cup-fungi (operculates), in 1928, there has been a steady demand for this work. All of the bound copies were disposed of some time ago and, much new material having accumulated since that time, it seemed best to the writer to issue the remaining unbound copies in a supplemented form. The new edition contains all the material in the first with nearly 100 additional pages of text and 28 additional plates, four of which are in color.

Since the Supplemented Edition is very limited in number, only about half those of the first, it is expected that the edition will be disposed of rather readily. For the benefit of those who do not wish to purchase the combined form, paper bound copies of the supplement alone are available. This book is privately published and for further details address the author.—FRED J. SEAVER.

A NOTE ON NOMENCLATURE

The evidence submitted by Dr. Rogers[1] indicates that S. F. Gray's *Natural Arrangement of British Plants* appeared later in

[1] Mycologia **33**: 568. 1941.

1821 than Volume I of Fries's *Systema,* and raises several interesting points. Under the present Rules, about forty generic and 230 specific names of Hymenomycetes may now be considered to have been first validly published in Gray's book.

As regards the Agaricaceae, the authorities for older generic and specific names are now being cited in various ways, as one author tries to follow the International Rules literally and another considers that the sub-genera of Fries are to be treated as, in effect, genera. The latter view was proposed for legalization by C. W. Dodge,[2] considered and rejected by the mycological section on nomenclature in 1935, then turned over to a committee, but has not yet come before the whole Congress. One may, therefore, still follow the latter practice until Congress makes a decision.

Those who interpret the Rules literally now have a new sourcebook and can cite, for example, *Amanita* (Fries) S. F. Gray, 1821 (or *Amanita* (Pers. ex Fries) S. F. Gray) with some assurance; Secretan (1833), Fries (1836 or 1838), Quélet (1872), and others have been presumed to be the first after the *Systema* to raise *Amanita* to generic rank. However, there are less fortunate results: to cite one example, *Crepidopus* (Nees) S. F. Gray (as well as *Resupinatus* and *Micromphale*) has priority over *Pleurotus* (Fries) Quél. But surely most of the familiar Friesian names should be conserved.

The International Rules state (Art. 4) "The essential points in nomenclature are: (1) to aim at fixity of names (2) to avoid or reject the use of forms and names which may cause error or ambiguity or throw science into confusion." Dr. Linder stressed this view in his Presidential Address.

Fries deservedly dominated mycology, although of course certain of his contemporaries excelled him in some one group or another. S. F. Gray was mainly a compiler. To validate the proposal to start the nomenclature of all "fungi caeteri" with Jan. 1, 1821, instead of 1821–32 would necessitate tiresome and futile search of the numerous publications of that period for the earliest "validation," whereas the start of each group from its publication in the *Systema* does give a definite citation at once. Many of Dr.

[2] Ann. Missouri Bot. Gard. **21**: 1934.

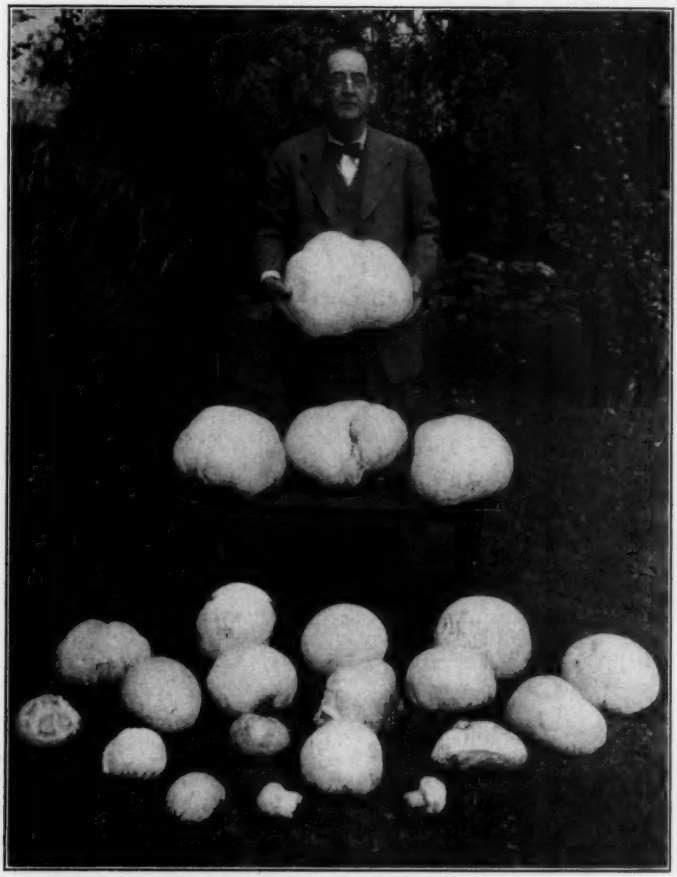
Dodge's arguments (loc. cit.) in favour of recognizing Friesian subgenera apply against starting with 1821. The correct authorities for many species not described as new in *Systema* II and III would be uncertain and variable, just as those of Agaricaceae are now. Take *Botrytis cinerea,* for example: S. F. Gray apparently did not compile it (though he has *Polyactis vulgaris*); in any event his work is presumed to date from November, 1821. Not until someone found the very first publication or exsiccatus issued on or after Jan. 1, 1821, with the name *B. cinerea* Pers., could he definitely "validate" the name as *"B. cinerea* Pers. ex X, 1821."

Incidentally, it seems to the writers that mycologists might well follow the example of Phanerogamic botanists and omit pre-valid author names except in formal taxonomic treatises, even though it be considered that a Persoon or a Link specimen is the type; *e.g.* use *Cladosporium herbarum* Fries instead of the awkward citation necessary to introduce both Persoon and Link (something like *C. herbarum* ([Pers.]) Link ex Fries). Also it should be noted that the *first* species an author cites under a new genus (with two or more species but no type specified) need not necessarily be chosen as lectotype.

We hope American mycologists will carry on the task of assembling and publishing data on nomina generica conservanda already proposed—some of them thirty years ago.—G. R. BISBY, E. M. MASON, AND E. M. WAKEFIELD.

PUFF-BALLS IN OHIO

The "puff-balls," the so-called fruiting bodies of the species *Calvatia gigantea,* shown in the accompanying illustration were collected along the Miami River not far from Quincy, Ohio, on October 19, 1941. The occasion was a vacation outing under the guidance of cousins (Mr. and Mrs. Arthur Davis of Jackson Center, Ohio) who are both well informed on, and highly appreciative of, the wild life and the natural beauty along the Miami River. In planning the day they had remarked that it was the season when puff-balls the "size of one's head" were to be found. The photo shows that their statement of comparison might well have made reference to a much swollen head.



A collection of giant puff-balls (*Calvatia gigantea*).

These puff-balls were found along the river in three localities separated by only a few miles. One was a grassy pasture with few scattering trees, and here the smallest of the specimens were found. The locality with the six largest puff-balls was a grassy slope leading to a vale. Nearby woods and scattering trees and stumps on the area indicated that a stand of timber had been removed in recent years. Here the puff-balls were mostly clustered with two

or more close together. Two of the largest of somewhat irregular shapes, in the photograph shown at the left on the table, had their stalks only about two inches apart at the level of the soil. In their expansion they had become closely pressed together. The third locality was one of rather densely wooded and steep slopes along a narrow vale in which there were springs and a small rivulet. There was no grass and there was a thin surface layer of leaf- and wood-humus which was deepest in pockets along the uneven slopes. Here the puff-balls were scattered, mostly solitary, and more nearly spherical.

A considerable number of other puff-balls were seen but not collected. Some of these were turning brown; some were of small size. No doubt many more specimens could have been found in other localities along the river.

The largest specimen weighed 10 lbs. and two ounces when weighed a few hours after it was collected. It was carefully packed in a bushel basket and brought by auto to the New York Botanical Garden for the mycological collection. At the present time its weight has decreased to 11 ounces. Evidently a fresh puff-ball of large size contains much water.

As for the fate of the other specimens. Most of them were consumed as food. A goodly number of them were distributed among friends and some of these had their first taste of puff-ball mushrooms. The persons who made the collection had their full share. In the preparation most favored by the writer a puff-ball that is fully white inside and quite solid is sliced, the outer rind is removed, and the slices are placed in weakly salted water for about twenty minutes. Then they are drained, dipped in a mildly seasoned batter of milk, melted butter, beaten eggs, and cracker or bread crumbs, and then fried to a brown in an iron skillet. The procedure is quite like that often employed in cooking egg plant. There are persons who consider puff-balls thus prepared to be a real delicacy.—A. B. STOUT.

A NOTE ON SEGREGATION TYPES IN GLOMERELLA

A paper which should prove of great interest to mycologists was presented by T. M. Sonneborn before the Genetics Society of

America meeting recently at Dallas. This author has investigated extensively the question of mating types in certain races of *Paramecium*. Without going into details it may be said he found, as he interprets his results, that the gene for mating type I mutates with high frequency to an allele for mating type II. Identical homozygous micronuclei give rise to diverse macronuclei which in turn determine mating types. The frequency of mutation varies from 35% to 87%, depending on the temperature within the range 10° to 35° C. This rate "is enormously greater than any hitherto recorded."

If Sonneborn's interpretations are allowable for his races of *Paramecium*, mycologists are certainly justified at least in considering again, even if not in adopting, the same reasoning to account for the interfertility of geographical races of mushrooms somewhat as suggested by Kniep, and also to explain the results obtained in their studies of *Glomerella* (Edgerton, Am. Jour. Bot. **1**: 244–254, 1914; Andes, Bull. Torrey Club **68**: 609–614, 1914; Lucas, Chilton & Edgerton in papers read before the Myc. Soc. Am. at Dallas). There is now agreement as to certain questions concerning *Glomerella*. A *light* or + race must very rarely sector or mutate to *dark* or — in plate cultures. If the eight spores are dissected from asci in ascocarps matured by a certain *"light"* race and are grown separately, three main types of segregation are shown to have occurred. (1) Rarely all eight spores give rise to *light* races or cultures. (2) All eight give rise to *dark* (—) races. (3) Four spores give *light* and four give *dark* races. Occasionally there is a 2:6 break. Essentially the same types of segregation occur when one selects asci from ascocarps maturing along the dark line of meeting where a *dark* race is grown opposite a *light* one in plate culture.

Since from only three asci out of some 140 (97% +) analyzed did Andes find all eight spores gave rise to *light* races, one would certainly be justified in refusing to consider mutation from *light* to *dark* to account for the small number of asci, in which no mutation was manifested. Before discarding this idea, one should consider another possibility. The nuclear history of our Glomerellas has not been adequately studied. Assuming for the moment, that *Glomerella cingulata* is homothallic, a single mutation from *light*

to *dark* occurring in a nucleus of a cell of a young ascogenous hypha would, because of proliferations, provide a number of asci which would be homozygous for dark and therefore would cut out eight *"dark"* spores. Four *"light"* and four *"dark"* spores in other asci in the same or other ascocarps would result from a similar mutation occurring in one of the two haploid nuclei fusing in the ascus so that after fusion it would be heterozygous for *light* and *dark*. Likewise a mutation at meiosis in an ascus homozygous for *light* would result the same way.

What is needed now more than anything else is the discovery of more genes, some linked with, some independent of, the genes for *light* and *dark*. In this way the question of homothallism versus heterothallism and of hybridization when *light* and *dark* races are opposed could most readily be settled.

Those who are investigating *Glomerella* are provided with a fungus which may serve beautifully to explain how homothallism may arise from heterothallism or vice versa, and how the effects of mutations may simulate effects of hybridization.—B. O. DODGE.

BOOK REVIEW

LEACH, J. G. *Insect Transmission of Plant Diseases.* xviii + 615 pages, 238 figures. McGraw-Hill Book Company, Inc., New York, 1940.

In the specialization of recent years adjacent fields have been investigated with such intensive concentration and such devoted single-mindedness that workers in one area often have been relatively unaware of developments in closely parallel or slightly divergent fields. As a result, when there emerges a book which synthesizes and correlates the material in related fields, interpreting and clarifying their interaction and interdependence, workers in these fields are greatly benefitted, further advances are directly stimulated, and science as a whole is markedly enriched.

Such a significant and valuable contribution is this book by Leach; in itself an outstanding contribution to Biology, and an immediate aid to plant pathologists, entomologists, and mycologists; in its influence a sure catalyst of further productive activity.

The book is adequate, able, well done. In it there is little to criticize, less to correct, naught to condemn.

The organization follows a well-thought out plan, proceeding progressively by logical steps in natural developmental sequence, its categories and subdivisions unfolding the subject matter in easily followed succession in its 17 chapters.

After the introduction has covered the historical and developmental background of the insect transmission of plant diseases, a general chapter outlines the interrelationships and interdependence of plants and insects through their close association in long evolutionary development, while chapter III discusses the intimate and more specialized relationships of symbiosis in its complex and biologically important aspects, and points out the bearing of these on plant pathology. Chapter IV, beginning the main line of the book, traces the growing appreciation of the relation of insects to the spread and development of plant diseases, from pioneer work such as that of Waite on fireblight through the rapidly increasing development that has led to the present, development in which Leach has been one of the most active contributors. Here also is discussed the part played by insects in such biologic problems as the origin of new diseases through hybridization of plant pathogens by means of insect transmission of their reproductive entities.

The six chapters which follow consider in specific detail the relation of insects to various categories of plant diseases, categories based, in my opinion very wisely, on the nature of the causal agent, rather than on the necrotic, hyperplastic, or hypoplastic reaction of the host. For each of these categories—diseases caused by toxicogenic insects, by bacteria, by fungi, by viruses, and by protozoa—there is an adequate and effective presentation of complex material hitherto dispersed, disorganized, and difficult of access. Especially commendable is the competent and thorough treatment in the 107 pages of chapters VIII and IX of the complicated relation of insects to virus diseases. Chapter XI with its discussion of mites, nematodes, and other small animals as vectors of plant diseases presents interesting parallels to the cases of insect transmission already considered and makes the reader realize that these and perhaps other living agencies should not be disregarded.

After these specific examples follow 4 chapters no less valuable, covering in about 90 pages matters important to the understanding of the field of insect transmission of disease in its wider, more general aspects. In their relation to insect transmission are discussed the anatomy and physiology of host plants and of insect vectors, the inocula of pathogens, and the feeding and breeding habits of insects. Illuminating and significant, also, is the 20-page chapter comparing the older field of the insect transmission of animal diseases, better known through work in medicine and economic entomology, with the more recently appreciated subject of insect transmission of plant diseases. A final chapter on methods of investigating the relation of insects to the spread and development of plant diseases makes available to the reader the strategy and tactics, the arms and equipment, for attacking the many problems yet unsolved.

As typographical errors, in keeping with the conscientious care manifest throughout, are signally few and will be corrected in subsequent editions, they do not detract from the text. Indeed, a few actually enliven it, "casual fungus" suggesting a lighter side to the grim activities of a pathogen, "interpendence" coining a neat word of definite potentialities, "drive nourishment from the host" suggesting hitherto unexpected blockade tactics, and "Zodiophilous" implying astrological relation to the Zodiac rather than biological relation to dissemination by animals.

Factual errors, as might be expected, are notably rare. The statement on page 28 that "all members of the Entomophthorales are exclusively parasitic on insects" is hard to reconcile with the mode of life of *Basidiobolus, Conidiobolus,* and *Completoria.* That this is the only critical mistake which attracted my attention may of course be due to the fact that the Phycomycetes are the only group of fungi with which I am familiar. Others, expert in other groups, may find additional errors, but I doubt if these will be numerous.

The 238 figures, comprising half-tones and line-cuts, are well chosen and effectively support and illustrate the text. They are uniformly excellent, only figure 77 suffering from "half-tone fog," so that the "eggs of the seed corn maggot, etc.," undoubtedly ob-

vious in the original glossy print, now are lost in the general camouflage unless pointed out to the uninitiated. For some reason the legends seem to have a greater proportion of typographical errors than the text. Some of these, also, have their brighter side, the male mite in figure 179 apparently kicking with all four pairs of appendages in protest against being labelled a "non-gravid female," while "mid-intestine of the lava" startles the reader by its unexpected lapse from Entomology into Vulcanology.

Each chapter of the book is a complete entity effective in itself, with its own adequate list of pertinent references; an advantage to the student investigator who is more likely first to consult individual chapters in connection with his work and later to read the book in its entirety. As a result, there is inevitable repetition in subject matter and in supporting references, but even to those who read the book in its entirety this repetition is not disadvantageous, the encountering of matter already grasped soothing the ego and aiding in the interpretation and understanding of additional material.

The appendix, of 22 pages, is a very valuable feature as, in 6 comprehensive tables which group causal agents and vectors in parallel columns and compare representative plant diseases with respect to significant features of transmission, essential facts necessarily overlaid with abundant detail in the text are here brought out vividly with helpful clarity of perspective. It is thus a skeletal exposition of similarities and differences, an abstract of essential features, facilitating ready and instructive comparison, a convenience for reference and for teaching.

The glossary of 9 pages, covering adequately the essential terminology of plant pathology, entomology, and mycology, as involved in the book, is valuable and useful. The definitions are clear and effective, well chosen and adequate, adding much to the value of the book, leaving little to criticize. Yet the definitions of facultative parasite and saprophyte, although clear, involve an unfortunate awkwardness of expression which Dr. Leach certainly would not accept in the writings of his students. Also, although the adjective *homosexual*, as here defined to mean "producing only one kind of gamete," might innocently enough be applied to your reviewer, such a characterization would certainly arouse my resentment con-

sidering the implications of the accepted usage of Webster's Dictionary or of psycho- rather than phyto-pathology.

The glossary is especially valuable to barbarians like myself, unversed in the Whetzelian terminology, since it explains the exact sense in which terms such as dissemination, transmission, inoculation, ingression, infection, etc., are used here. Consistent adherence to this terminology, however, seems to be difficult even for the author since, despite his loyal usage of "suscept," he occasionally, as on pp. 189, 408, et al., descends to the ostracized word "host." Also the author is forced, in his discussion under "transmission," to attempt justification of "Insect Transmission of Plant Diseases" as his title, a heinous example of the "baneful influence" of mycology and of "the prevalent practice of treating the pathogene and the disease as synonymous concepts," flagrantly contrary to the Maestro's insistence that "Disease is a physiological process, or better, perhaps, an interrelated group of processes; . . . the composite of reactions of the plant to the causal factor or factors operating upon it."

An excellent working index of 20 pages, well organized, inclusive, and usable, completes the book.

The book is of two-fold value. As a comprehensive, thorough, and able presentation of hitherto unassembled material in an important field it fills a long-felt need and is most welcome. In addition, as a stimulus to further research it may well prove even more valuable to science. Throughout its pages the attitude of the investigator is revealed, for, along with his masterly assembly of what already has been accomplished, Leach points out what needs to be done, the significant questions unanswered, the interesting points still obscure, the important problems as yet unsolved. By a mere compiler the things that need to be done are often unnoticed, but to an active and inquiring investigator such as Leach, years of active work, together with the absorption of a vast amount of literature pertinent thereto, reveal innumerable problems that clamor for solution.

Furthermore, to the investigator with broad vision, the solution of such problems for the advancement of science is more important than their retention for the advancement of the individual. Hence in this book there is no jealous withholding of stimulative sugges-

tion, no hoarding of potential problems for the benefit of the writer and his students. On the contrary, the book is rich in stimulative suggestions, practically every page pointing out some important problem in need of investigation, some question of significance as yet unanswered. As a result, your reviewer predicts an increase of activity in this field. The student who, on reading a book so complete and comprehensive, is likely to consider the field closed with nothing left to do cannot possibly react in that way to this book. To the beginner, whether plant pathologist, mycologist, or entomologist, this book gives long sought stimulus, guidance, and inspiration. He may start reading with his mind in the condition of page 594, but by the time he has reached that page he will have been furnished numerous problems in his own field of interest, supplied with helpful background, methods, and references, and aroused into investigative activity.

Indeed, among advanced workers the catalytic effect of this book is certain to activate further investigation valuably contributive to the advancement of Biology.

"To the vector belong the spoils"; to the author belongs the credit for a significant and stimulative contribution.—WM. H. WESTON.

MYCOLOGICAL SOCIETY OF AMERICA

REPORT ON THE 1940 FORAY

The 1940 Foray was held in the Mt. Katahdin region of Maine, August 20–24, with the collaboration of the Department of Botany and Entomology of the University of Maine. Headquarters were at Millinocket. The attending mycologists found very pleasant and convenient living quarters at the excellent Great Northern Hotel and adjacent tourist homes, a situation which made for close social relationships that resulted in one of the most enjoyable Forays in recent years. Satisfactory laboratory facilities were provided by the Millinocket School Board not very far from the living quarters. The collecting trips were organized by Dr. F. H. Steinmetz of the University of Maine. The collecting grounds, which should have been excellent, were at Norcross, the trails of

Mt. Katahdin and the environs of Millinocket. The Reverend Stanley A. Gould of Millinocket graciously acted as local host, assisting in making local arrangements and in the collecting, and in entertaining those of the party not interested in the field trips.

Thirty-seven people were in attendance, twenty mycologists and the remainder wives, children or friends.

The usual meeting which followed a dinner at the Great Northern Hotel, was presided over by the President of the Society, Dr. D. H. Linder. The usual resolutions were passed expressing the appreciation of the Society for the efforts of the following individuals or organizations: Dr. F. H. Steinmetz for his part in planning for and carrying out the Foray; the Millinocket Chamber of Commerce for assistance in arranging the Foray; the Millinocket School Board for providing excellent laboratory space at the High School; the Rev. Stanley A. Gould for contributing his time, services and geniality on all occasions. There was the usual discussion of the Foray for 1941. It was voted that the Committee on arranging this Foray should prepare a complete list of collections for publication in MYCOLOGIA.

The Mt. Katahdin area was selected for this Foray originally because of the generally expressed desire for an opportunity to collect in some part of Maine and also because this region was recommended as one where year-in and year-out moisture conditions are favorable for fungous growth. By the perversity of fate, however, it was found upon arrival that this year was the driest in 40 years, with no rain for 6 weeks. The situation was saved only by an all-day rain the day before the Foray opened. Therefore the collecting was not as good as expected.

During and just after the Foray 394 species and varieties were collected, not a bad number for the preceding bad weather conditions. The symbols in parentheses indicate the sources of the reports from which the list was compiled. Unfortunately, the collections of L. O. Overholts are not included here.

C = Victor M. Cutter, Jr., Cornell University
H = L. K. Henry, Carnegie Museum, Pittsburgh
K = F. D. Kern, Pennsylvania State College
L = D. H. Linder, Farlow Herbarium, Harvard University

M = G. W. Martin, University of Iowa
P = A. G. Plakidas, Louisiana State University
S = C. L. Shear, Washington, D. C.
Si = J. W. Sinden, Pennsylvania State College
Sn = Walter H. Snell, Brown University
St = F. H. Steinmetz, University of Maine
Ste = Neil E. Stevens, University of Illinois
T = G. S. Torrey, University of Connecticut
W = Maurice B. Walters, Cleveland, Ohio
Wh = combined collections of H. H. Whetzel and Thomas Sproston.

The Myxomycetes marked with an asterisk (*) were developed in moist chambers by G. W. Martin.

ACRASIEAE: *Polysphondylium pallidum* Olive (M).

MYXOMYCETES: *Arcyria cinerea* (Bull.) Pers. (M, L); *A. incarnata* Pers. (M); *A. nutans* (Bull.) Grev. (M); *Badhamia rubiginosa* (Chev.) Rost. (M); *Ceratiomyxa fruticulosa* (Mull.) Macbr. (H, M, T); **Comatricha elegans* (Racib.) List. (M); **C. pulchella* (Bab.) Rost. (M); *C. typhoides* (Bull.) Rost. (M); *Craterium minutum* (Leers) Fr. (M); **Cribraria microcarpa* (Schrad.) Pers. (M); *C. tenella* Schrad. (M); *Diachea leucopodia* (Bull.) Rost. (M); **Dictydium cancellatum* (Batsch) Macbr. (M); **Diderma effusum* (Schw.) Morg. (M); *D. globosum* Pers. (S); *D. testaceum* (Schrad.) Pers. (L, M, S); *Didymium complanatum* (Batsch) Rost. (M); *D. minus* Morg. (M); *D. squamulosum* (A. & S.) Fr. (L, M); *D. xanthopus* (Ditm.) Fr. (M); **Echinostelium minutum* deBy. (M); *Fuligo septica* (L.) Wigg. (M); *Hemitrichia clavata* (Pers.) Rost. (L); *H. Serpula* (Scop.) Rost. (T); *H. stipitata* (Massee) Macbr. (M); *H. Vesparium* (Batsch) Macbr. (M); **Lamproderma scintillans* (Berk. & Br.) Morg. (L, M); *Leocarpus fragilis* (Dicks.) Rost. (H, M, S); **Licea minima* Fr. (M); *Lycogala epidendrum* (L.) Fr. (M); **Ophiotheca chrysosperma* Currey (M); **Orcadella operculata* Wingate (M); *Physarum bivalve* Pers. (L); *P. cinereum* (Batsch) Pers. (M); **P. globuliferum* (Bull.) Pers. (M); *P. viride* (Bull.) Pers. (L, M); *Reticularia lycoperdon* Bull. (Sn); *Stemonitis flavogenita* Jahn (M); *S. fusca* Roth (M); **S.*

nigrescens Rex (M); *Trichia favoginea* (Batsch) Pers. (M); *T. persimilis* Karst. (M); *Tubifera ferruginosa* (Batsch) Gmel. (M).

PHYCOMYCETES: *Mucor plumbeus* Bon. (C); *M. racemosus* Fres. (C); *Peronospora obducens* Schroet. (L); *Sporodinia grandis* Link (C).

PYRENOMYCETES: *Amphisphaeria aethiops* (B. & C.) Sacc. (S); *Chromocrea gelatinosa* (Tode) Seaver (L); *Claviceps purpurea* (Fr.) Tul. (L); *Cordyceps acicularis* Rav. (L); *Daldinia concentrica* Bolt. ex Fr. (L, S); *Dialonectria Peziza* (Tode) Seaver (L); *Diatrype stigma* (Hoff.) Fr. (S); *Diatrypella verrucaeformis* (Ehr.) Nat. (S); *Erysiphe Chelonis* Schw. (= *E. Galeopsidis* DC *sensu* Salmon) (L); *E. lamprocarpa* (Wallr.) Duby (L); *Eutypa flavovirens* (P.) Tul. (S); *Eutypella cerviculata* (Fr.) Sacc. (S); *Fenestella princeps* Tul. (S); *Glonium lineare* (Fr.) de Not. (S); *Hypocrea patella* Cke. & Pk. (M); *H. rufa* (Pers.) Fr. (L, M); *Hypomyces aurantius* (Pers.) Tul. (L); *H. lactifluorum* (Schw.) Tul. (M, St); *H. polyporinus* Pk. (H); *Hypoxylon caries* (Schw.) Sacc. (S); *H. cohaerens* (Pers.) Fr. (H); *H. commutatum* Nke. var. *holwayanum* S. & E. (S); *H. fuscum* (Pers.) Fr. (S); *H. Lakei* B. & C. (S); *H. multiforme* Fr. (S); *H. rubiginosum* (Pers.) Fr. (S); *Lasiosphaeria crinita* (Pk.) Sacc. (S); *L. hispidula* (Tode) Fckl. (L); *L. viridicoma* (Pk.) Sacc. (S); *Massaria inquinans* (Tode) Fr. (S); *Nectria cinnabarina* (Tode) Fr. (S); *N. Coryli* Fckl. (L); *N. episphaeria* (Tode) Fr. (L); *Pleurostoma Candollei* Tul. (L); *Rosellinia ligniaria* (Grev.) Nits. (S); *Ustulina vulgaris* Tul. (H, S, T); *Valsa abietis* Fr. (S); *V. pauperata* Cke. & Ell. (L); *Valsaria exasperans* (Ger.) Sacc. (S); *Xylaria corniformis* auct. Amer. not Fr. (S, T); *X. filiformis* (A. & S.) Fr. (S); *X. hypoxylon* (L.) Grev. (L).

DISCOMYCETES: *Caliciopsis pinea* Pk. (S); *Chlorociboria versiforme* (Pers.) Seaver (L); *Chloroscypha Jacksoni* Seaver (L); *Chlorosplenium aeruginosum* (Oed. ex Fr.) de Not. (H, S); *Clithris morbida* (Pk.) E. & E. (S); *Cudonia circinans* (Pers.) Fr. (Wh); *Dasyscypha Agassizii* (B. & C.) Sacc. (L, S, Sn); *Dasyscyphella vitis* (S.) Sacc. (S); *Dermatea acerina* (Pk.) Rehm (Wh); *D. balsamea* (Pk.) Seaver (S); *D. molliuscula* (Schw.)

Cash (S); *Discinella livido-purpurea* Boud. (L); *Godronia Linnaeae* Karst. (S); *Helotium album* Schum. (Wh); *H. citrinum* (Hedw.) Fr. (L); *H. epiphyllum* (Pers. ex Fr.) Fr. (Wh); *H. fastidiosum* Pk. (S, Wh); *H. fraternum* Pk. (L); *H. phyllophilum* (Desm.) Karst. (Wh); *Lachnella corticalis* Pers. ex Fr. (L); *Lachnum ?Arundinariae* Cash (L); *L. leucophaeum* (Nyl.) Karst. (S); *L. virgineum* (Batsch ex Fr.) Karst. (S); *Lasiobolus pilosus* (Fr.) Sacc. (M); *Leotia lubrica* (Scop.) Pers. (L); *Microglossum rufum* (L. v. S.) Underw. (Wh); *Mollisia benesuada* (Tul.) Rehm (Wh); *M. cinerea* (Batsch) Rehm (Wh); *M. ramealis* Karst. (S); *M. stictella* Sacc. & Speg. (S); *Orbilia coccinella* (Sommerf.) Karst. (L); *O. leucostigma* Fr. (S); *O. xanthostigma* Fr. (S); *Patella scutellata* (L.) Morg. (H); *Paxina macropus* (Clements) Seaver (Sn); *Pezicula acericola* (Pk.) Sacc. (L, S); *P. carnea* (Cke. & Ell.) Rehm. (S); *P. subcarnea* Grove (S); *Phialea cyathoidea* (Bull. ex Fr.) Gill. (S); *P. dolosella* (Karst.) Sacc. (S); *Psilopezia deligata* (Pk.) Seaver (L); *Rutstroemia macrosporum* (Pk.) Kanouse (L); *R. petiolorum* (Rob.) White (Wh); *R. sulfurella* (Pk.) White (L); *Sclerotinia sclerotiorum* (Lib.) deBy. (Wh); *Scodellina leporina* (Batsch) S. F. Gray (H); *Spathularia velutipes* Cke. & Farl. (H, Sn, T, Wh); *Stictis radiata* Pers. ex Fr. (L); *Tympanis fasciculata* Schw. (S).

OTHER ASCOMYCETES: *Adelopus balsamicola* (Pk.) Thiessen (Sn, Wh); *Coccomyces coronatus* (Schum.) Rehm (S); *C. c.* var. *laciniatus* Schw. (Wh); *Cryptomyces pteridis* (Fr.) v. Hoehn. (M); *Lophodermium melaleucum* (Fr.) de Not. (T); *L. Thujae* J. J. Davis (L, Wh); *Phacidium Vaccinii* Fr. (Wh); *Phyllachora graminis* (Pers.) Fckl. (K); *Plowrightia morbosa* (Schw.) Sacc. (H); *Rhytisma canadensis* Pk. (S, Sn, Wh); *R. ilicis-canadensis* Schw. (H, Sn, St); *R. salicinum* (Pers.) Fr. (Sn); *Taphrina Alni-incanae* (Kühn) Magn. (H, Sn).

LOWER HETEROBASIDIOMYCETES: *Calocera cornea* (Batsch) Fr. (L); *Dacrymyces abietinis* (Pers.) Schroeter (S); *D. deliquescens* Duby (M); *D. palmatus* (Schw.) Bres. (L, M, Sn); *Dacryomitra brunnea* Martin (M); *Exidia nucleata* (Fr.) Burt (L. M); *Gloeotulasnella tremelloides* (Wakef. & Pears.) Rogers (M); *Sebacina caesio-cinerea* (v. H. & L.) Rogers (M); *S. epigea* (Berk. & Br.)

B. & G. (M); *S. Galzinii* Bres. (M); *S. incrustans* (Fr.) Tul. (L, M); *S. podlachica* Bres. (M); *Stypella minor* Möller (M); *Tremella lutescens* Pers. (H); *T. mesenterica* Fr. (M); *Tremellodon gelatinosum* (Scop.) Pers. (L); *Tulasnella pruinosa* B. & G. (M).

UREDINALES: *Calyptospora Goeppertiana* Kühn [=*Pucciniastrum Goeppertianum* (Kühn) Kleb.] (K, T. Wh); *Chrysomyxa chiogenis* Diet. (Wh); *C. ledi* (A. & S.) deBary (L, S. Sn, Wh); *C. ledicola* (Pk.) Lagerh. (L, Sn, St, T, Wh); *Cronartium ribicola* Fisch. (K, L, Sn, St); *Gymnosporangium aurantiacum* Chev. [=*G. cornutum* (Pers.) Arth] (H, Ste, T); *Melampsora medusae* Thüm (Sn); *Peridermium balsameum* Pk. (T); *Puccinia angustata* Pk. (K, Si); *P. a.* var. *typica* Arth. (L); *P. Caricis* (Schum.) Schroet. (L); *P. caricis grossulariata* Arth. (S); *P. Grossulariae* (Schum.) Lagerh. (K, Si); *P. Helianthi-mollis* (Schw.) Jacks. (K, Si); *P. Hieracii* (Schum.) Mart. (S); *P. obtegens* Tul. (T); *P. Poae-sudeticae* (Westend.) Jørstad (K, Si); *P. porphyrogenita* M. A. Curt. (K, L, Si, Sn, T, Wh); *P. Violae* (Schum.) DC. (L, S); *Pucciniastrum americanum* (Farl.) Arth. (K, Si, Sn, T); *P. Geoppertianum* (Kühn) Kleb. (see *Calyptospora*); *P. Myrtilli* (Schum.) Arth. (K, T); *P. Potentillae* Kom. (T); *Uredinopsis mirabilis* (Pk.) Magn. (L, S); *U. Osmundae* Magn. (K, L, M, S, T, Wh); *U. Phegopteridis* Arth. (St); *U. Struthiopteridis* Störmer (Wh); *Uromyces Hyperici* (Spreng.) Curt. (L); *Uromyces striatus* Schroet. (L).

THELEPHORACEAE: *Aleurodiscus amorphus* (Pers.) Rabenh. (H); *A. Farlowii* Burt. (S, T); *Asterostroma ochrostroma* Burt (=*Asterodon ferruginosum* Pat. of the Hydnaceae) (T); *Botryobasidium coronatum* (Schroet.) Donk (L); *B. isabellinum* (Fr.) Rogers (M); *B. vagum* (B. & C.) Rogers (M); *Coniophora olivacea* (Fr.) Karst. (M); *?C. sistotremoides* (Schw.) Massee (M); *Corticium arachnoideum* Berk. *sensu* Bres. (L); *C. galactinum* Fr. ex Burt. (L, M, Sn, St); *C. livido-caeruleum* (Karst.) v. Hoehn. & L. (M); *C. roseo-carneum* (Schw.) Fr. (St); *C. subpallidum* Litsch. (=*C. calceum* Fr. ex Burt.) (M); *C. sulphureum* (Pers.) Fr. (=*Hypochnus fumosus sensu* Burt) (M, St); *?C. Tsugae* Burt (M); *Craterellus lutescens* Pers. ex Fr. (or *Cantharellus lutescens* Fr.) (W); *Hymenochaete cinnamomea* Bres. (M);

?*H. spreta* Pk. (M); *H. tabacina* (Sow.) Lév. (H, M, St, T); *Peniophora alutacea* (Karst.) v. Hoehn. & Litsch. (L); *P. argillacea* Bres. (M); *P. carnosa* Burt (M); *P. cinerea* (Pers.) Cke. (M); *P. cremea* Bres. (L); *P. hydnoides* Cke. & Mass. (L); *P. longispora* (Pat.) v. Hoehn. (L); *P. piceina* Overh. (M); *P. mutata* (Pk.) Bres. (T); *P. sanguinea* (Fr.) Bres. (M); *P. tenuis* (Pat.) Mass. (L); *Phlebia strigoso-zonata* (Schw.) Lloyd (L); *Porothelium fimbriatum* Fr. (L, M); *Solenia anomala* (Fr.) Fckl. (M); *S. fasciculata* Pers. (H); *S. polyporoidea* Pk. (M); *Stereum fasciatum* Schw. (H); *S. Murrayi* (B. & C.) Burt (M, Sn, St, T); *S. roseo-carneum* (Schw.) Fr. (St); *S. rufum* Fr. (L, St); *S. sanguinolentum* A. & S. ex Fr. (Sn, T); *Thelephora griseozonata* Cke. (M); *T. terrestris* Ehrh. (St); *Tomentella atrorubra* (Pk.) B. & G. (M); *T. botryoides* (Schw.) B. & G. (M); *T. coriaria* (Pk.) B. & G. (L); *T. fuliginea* (Burt) B. & G. (L); *T. olivascens* (B. & C.) B. & G. [= *Hypochnus olivascens* (B. & C.) Burt] (M).

CLAVARIACEAE: *Clavaria amethystinoides* Pk. (L); *C. fusiformis* Sow. (Sn); *Physalacria inflata* Pk. (L, Sn); *Typhula* sp. (Wh).

HYDNACEAE: *Asterodon ferruginosum* Pat. (including *Asterostroma ochrostroma* Burt) (M, T); *Grandinia farinacea* (Fr.) B. & G. (M); *Mucronella aggregata* Fr. (M); *Odontia cristulata* Fr. (M); *O. fimbriata* Fr. (M); *O. stipata* (Fr.) Quél. (M); *Radulum orbiculare* Fr. (Sn, St); *R. quercinum* Fr. (M).

POLYPORACEAE: *Daedalea confragosa* (Bolt.) Fr. (H, St); *D. unicolor* (Bull.) Fr. (Sn, St); *Favolus canadensis* Kl. (H, Sn, St); *Fomes applanatus* (Pers.) Wallr. (H, St, T); *F. conchatus* (Pers.) Gill. (H, St); *F. connatus* (Weinm.) Gill. (Sn, St); *F. fomentarius* (L.) Gill. (H, Sn, St); *F. igniarius* var. *laevigatus* (Fr.) Overh. (L, Sn, T); *F. pinicola* (Sw.) Cke. (H, St); *F. roseus* (A. & S.) Cke. (H); *F. scutellatus* (Schw.) Cke. (S, Sn); *F. subroseus* (Weir) Overh. (H, St, T); *Lenzites betulina* (L.) Fr. (H); *L. saepiaria* (Wulf.) Fr. (H, Sn, St); *Polyporus abietinus* (Dicks.) Fr. (H, Sn, St); *P. adustus* (Willd.) Fr. (H, L, Sn, St); *P. albellus* Pk. (H, L, Sn, St); *P. anceps* Pk. (Sn, St); *P. betulinus* Bull. ex Fr. (H, St); *P. brumalis* Pers. ex Fr. (Sn);

P. cinnabarinus (Jacq.) Fr. (H, St); *P. elegans* Bull. ex Fr. (H, Sn); *P. galactinus* Berk. (L); *P. hirsutus* (Wulf.) Fr. (H, St); *P. pargamenus* Fr. (H, Sn, St); *P. perennis* L. ex Fr. (H, Sn); *P. radiatus* (Sow.) Fr. (Sn); *P. resinosus* (Schrad.) Fr. (St); *P. rheades* Pers. ex Fr. var. *vulpinus* (Fr.) Overh. (Sn); *P. semipileatus* Pk. (H); *P. Tsugae* (Murr.) Overh. [=*Ganoderma lucidum* (Leyss.) Karst.] (St); *P. Tulipiferae* (Schw.) Overh. (H); *P. varius* Pers. ex Fr. (St); *P. versicolor* L. ex Fr. (H, Sn, St, T); *Poria euporia* (Karst.) Cke. (S); *P. medulla-panis* (Pers.) Cke. (Sn); *P. nigrescens* Bres. (Sn); *P. prunicola* (Murr.) Sacc. & Trott. (Sn); *P. semitincta* Pk. (St); *Trametes americana* Overh. (H); *T. serialis* Fr. (St); *T. variiformis* Pk. (Sn, St).

BOLETACEAE: *Boletus auriporus* Pk. (M, Sn); *B. badius* Fr. (Sn); *B. felleus* Bull. ex Fr. (Sn); *B. granulatus* L. ex Fr. (M, Sn); *B. niveus* Fr. (=*B. holopus* Rostk.) (Sn).

AGARICACEAE: *Amanita phalloides* Fr. (H); *Amanitopsis vaginata* Fr. (L, Sn); *A. v.* var. *fulvus* Sacc. (H, L); *Clitocybe laccata* Fr. (H); *Collybia cirrata* Fr. (Wh); *C. dryophila* Fr. (L, H); *C. radicata* (Relh.) Berk. (L); *C. r.* var. *furfuracea* Pk. (H); *Crepidotus applanatus* Fr. (H, Sn, St); *Flammula sapinea* Fr. (H, Sn); *Galera tibiicystis* Atk. (L); *Hygrophorus ceraceus* Fr. (Sn); *H. miniatus* Fr. (H, Sn); *Inocybe lacera* Fr. (H); *Lactarius deceptivus* Pk. (Sn); *L. deliciosus* Fr. (Sn); *L. fuliginosus* Fr. (Sn); *L. subdulcis* Fr. (Sn); *L. torminosus* Schaeff. ex Fr. (T); *Marasmius rotula* Fr. (H); *Mycena corticola* Fr. (H); *M. haematopa* Fr. (H); *Naucoria siparia* Fr. (L); *Panus rudis* Fr. (H, Sn); *P. stypticus* Fr. (H, Sn, St); *Paxillus atrotomentosus* Batsch ex Fr. (T); *P. involutus* Fr. (H, Sn); *Pholiota erinaceella* Pk. (Sn); *Pleurotus candidissimus* Berk. & Curt. (L); *Pluteus cervinus* Fr. (Sn) and var. *albus* Pk. (Sn); *P. nanus* Fr. (Sn); *Russula aeruginea* Lindb. (Sn); *R. borealis* Kauffm. (L); *R. decolorans* Fr. (Sn); *R. emetica* Fr. (Sn); *R. fallax* Cke. (Sn); *R. flava* Romell (Sn); *R. foetens* Fr. (L); *R. fragilis* Fr. (Sn); *R. puellaris* Fr. (Sn); *R. rugulosa* Pk. (L); *R. subfragilis* Burl. (Sn); *R. variata* Bann. (Sn); *R. xerampelina* Fr. (Sn); *Schizophyllum commune* Fr. (H, St); *Stropharia semiglobata* Fr. (H); *Tricholoma rutilans* Fr. (Sn); *Trogia crispa* Fr. (St).

GASTEROMYCETES: *Lycoperdon muscorum* Morg. (L); *L. pyriforme* Schaeff. (H, L); *L. subincarnatum* Pk. (T); *L. umbrinum* Pers. (S).

FUNGI IMFERFECTI: *Cladosporium humile* J. J. Davis (P); *Gloeosporium punctiforme* Ell. & Ev. (Wh); *Glomerularia Corni* Pk. (Si); *Helicoma Curtisii* Berk. (L); *Helicomyces scandens* Morg. (L); *Rhopalomyces elegans* Corde (M); *Septoria acerina* Pk. (L, Wh); *Troposporella fumosa* Karst. (M); *Verticillium Lactarii* Pk. (L).

POST-FORAY COLLECTIONS, Cushing and Friendship, Maine, by Snell.

POLYPORACEAE: *Polyporus fibrillosus* Karst. (on gray birch); *P. perennis* L. ex Fr. BOLETACEAE: *Boletinus cavipes* (Opat.) Kalchbr.; *B. glandulosus* Pk.; *Boletus americanus* Pk.; *B. chromapes* Frost; *B. edulis* Bull. ex Fr.; *B. elegans* Schum. *sensu* Fr.; *B. granulatus* L. ex Fr.; *B. niveus* Fr. (= *B. holopus* Rostk.); *B. piperatus* Bull. ex Fr.; *B. scaber* Bull. ex Fr.; *B. subluteus* Pk.; *B. versipellis* Fr.; *B. viscidus* L. ex Fr. AGARICACEAE: ?*Amanita bisporigera* Atk.; *A. flavoconia* Atk.; *A. frostiana* Pk.; *Armillaria imperialis* Fr.; *Gomphidius flavipes* Pk.; *Russula alutacea* Pers. ex Fr.; *R. foetens* Fr.; *R. sordida* Pk.; *Tricholoma sejunctum* Fr.

In addition, undescribed species collected by Whetzel and Sproston are recognized as follows: an *Helotium* to be described by W. Lawrence White; a *Coprinus* to be described by Overholts.—WALTER H. SNELL.